

Radio Fun

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"The beginner's guide
to the exciting world
of amateur radio."

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How To Work DX



Are you a recently-licensed amateur, anxious to work some long-distance QSOs? This month, Steve Katz WB2WIK/6 will bring you up to speed on how to make your first DX contact. Turn to "The Mistakes New DXers Make, Part 1," starting on page 4.

Ham Radio Legislation Progress

The House of Representatives Joint Resolution 199 took a giant step toward becoming public policy recently, when key provisions were included in H.R. 4522, the FCC Authorization Act of 1994, during a meeting of the Telecommunications Subcommittee of the House Energy and Commerce Committee. Drawn-up by the ARRL and sponsored by Representative Mike Kreidler (D-WA), H.J. 199 earlier gained 245 other Congressional cosponsors as a result of hard work from members of the ham radio community.

The bill urges the FCC to "continue and enhance the development of amateur radio as a public benefit by adopting rules and regulations encouraging the use of

new technologies," and urges the commission to make "reasonable accommodations for the effective operation of amateur radio from residences, private vehicles and public areas," and urges "all levels of government" to facilitate amateur radio as a public benefit.

The bill calls for a one-time fee for a vanity callsign of \$150. The previous annual fee provision was tabled, staving off the threat of annual fees for amateurs. The ARRL lobbied to direct the one-time fees to the FCC rather than to the Treasury. The next step would be action by the full Energy and Commerce Committee, followed by consideration on the floor of the House. *TNX Westlink Report, No. 677, August 2, 1994.*

FCC Reorganizes

In August, FCC Chairman Reed Hundt announced a massive organizational overhaul at the Federal Communications Commission. New creations include: a Wireless Telecommunications Bureau, an International Bureau, an Office of Workplace Diversity, and a Competition Division in the Office of General Counsel.

Among other changes, the Office of Small Business Activities was moved out of the Office of Managing Director and will now report directly to the Commission. The FCC will now operate with six bureaus. Besides Wireless Telecommunications and International, the other four bureaus are the Common Carrier, Mass Media, Field

Operations, and Cable Services.

The Private Radio Bureau was absorbed into the new Wireless Telecommunications Bureau, which will license and administer all personal communications service (PCS) licensing and other emerging technologies. The International Bureau will concentrate on global satellite and treaty-related issues. *TNX W5YI Report, Issue #16, August 15, 1994.*

UK to QRO

Power restrictions in Great Britain have been lifted on sections of the 1.8 and 50 MHz bands, according to the Radio Society of Great Britain. Antenna and ERP (effective radiated power) restrictions no longer apply on 50 MHz, either.

Holders of the amateur Class A license may transmit with 400 watts from 1.81 to 1.85 MHz, but the power limit from 1.85 to 2.0 MHz remains at 10 watts.

Holders of the full amateur Class A and B licenses may now run up to 400 watts between 50 and 51 MHz. The maximum permitted power between 51 and 52 MHz is still 100 watts. The ERP and antenna height restrictions have been removed from 50 to 52 MHz, allowing the use of any antenna, including maritime mobile operation.

All UK amateurs are now required to notify their Radio Investigation Service office of

unattended digital operation. The RSGB says this additional restriction was necessary following a number of problems with unattended operations. "The procedure is far less onerous than that required for a repeater or beacon on a hilltop site, and requires only the agreeing of suitable emergency close-down procedures," the RSGB said. *TNX Mohawk Amateur Radio Club, Inc. News, August, 1994; and the ARRL.*

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AIRCRAFT RECEIVER



Hear exciting air-craft communications—pick up planes up to 100 miles away! Receives 110-136

MHz AM air band, smooth varactor tuning superhet with AGC, ceramic filter, adjustable squelch, excellent sensitivity and lots of speaker volume. Runs on 9V battery. Great for air shows or just hanging around the airport! New 30-page manual details pilot talk, too. Add case set for "pro" look.

AR-1 kit.....\$29.95 Matching case set, CAR...\$14.95

FM RECEIVERS & TRANSMITTER

Keep an ear on the local repeater, police, weather or just tune around. These sensitive superhet receivers are fun to build and use. Tunes any 5 MHz portion of the band and have smooth varactor tuning with AFC, dual conversion, ceramic filtering, squelch and plenty of speaker volume. Complete manual details how the rigs work and applications. 2M FM transmitter has 5W RF out, crystal control (146.52 included), pro-specs and data/mike inputs. Add our case sets for a nice finish.

FM Receiver kit Specify band: FR-146 (2M), FR-6 (6M), FR-10 (10M), FR-220 (220MHz).....\$29.95
CFR Matching case set.....\$14.95
FT-146 Two Meter FM transmitter kit.....\$79.95

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World's smallest FM wireless mike. Smaller than a sugar cube - including battery and mike. Two sets of SMT parts supplied in case you are clumsy! Terrific audio pick-up (pin drop at 5 ft) and transmit range of 300 ft. We include the battery (watch style), electret mike and even a tuning tool! Be a James Bond and learn SMT too! FM-5 Micro mike kit.....\$19.95



FM WIRELESS MIKES

Pick the unit that's right for you. All units transmit a stable signal in the 88-108 MHz FM band up to 300' except for High power FM-4 and PB-1 Phone bug that go up to 1/2 mile.

FM-1 Basic unit.....\$5.95
FM-2, as above
but with added mike pre amp.....\$7.95
FM-4, long range with
very sensitive audio pickup.....\$14.95
PB-1, Phone bug needs no battery,
hooks to phone line.....\$14.95
MC-1, Micro size sensitive mike cartridge
for FM-1,2,4.....\$2.95

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Add concert hall realism to your stereo, TV or even 2-way radio! Easily synthesize a stereo effect from mono sources or richly enliven regular music. Add a big-voice reverb to your radio voice that others will envy! Our reverb/surround sound kit uses a Bucket Brigade IC Device for reliable solid-state performance. Adjustable reverb, delay and mix controls to customize your sound. Easily connected to radios, stereos, CB's and TV's. Plenty of audio to drive a small speaker for stand-alone operation too. Experience the fun and realism that surround sound provides - without spending hundreds! Add our case set for a neat, pro look.

RV-1 Surround Sound/Reverb kit.....\$59.95 CRV Matching case set.....\$14.95
RV-1WT Assembled RV-1 and case.....\$99.95

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Control virtually anything by Touch-Tone remote control. The URC-1 has 16 switched outputs, 4 adjustable voltage outputs (20 mV steps 0 to 5 VDC), two 10K digital pots (for volume, squelch, etc.) and 3 timers adjustable from 10 ms to 40 hours! Two level password control allows secure control and multi-level access. Six digit LED display shows currently entered codes and a crystal controlled touch-tone decoder provides reliable operation. There's nothing else like this unit, be in complete control of remote radios, thermostats, hi-fi's, homes or even factories with the URC-1. Add our matching case set for a handsome finish.

URC-1 Remote control kit.....\$129.95 CURC Matching case set.....\$14.95
URC-1WT Fully assembled URC-1 and case.....\$189.95

FM SUBCARRIER DECODER

Tap into the world of commercial-free music and data that is carried over many standard FM broadcast radio stations. Decoder hooks to the demodulator of FM radio and tunes the 50-100 KHz SCA subcarrier band. Many radios have a demod output, but if your radio doesn't, it's easy to locate, or use our FR-1 FM receiver kit which is a complete FM radio with a demod jack built-in. These "hidden" subcarriers carry lots of neat programming - from stock quotes to news to music, from rock to easy listening - all commercial free. Hear what you've been missing with the SCA-1.

SCA-1 Decoder kit.....\$27.95 CSCA Matching case set.....\$14.95
FR-1 FM receiver kit.....\$24.95 CFR Matching case for FR-1.....\$14.95

L-C METER

Measure inductors from 10 uH-10mH and capacitors from 2 pF-2uF with high accuracy by connecting the LC-1 to any digital multimeter. Two pushbutton ranges for high resolution readings and we even give you calibration components to assure proper accuracy of your kit! Active filters and switching supplies require critical values, no one should be without an accurate LC meter. For a pro look, add our matching case set.

LC-1 LC meter kit.....\$34.95 CLC case set.....\$14.95

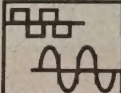
MOTOR CONTROLLER

Control the speed and direction of any motor. Use our SMD-1 for those nice steppers you see surplus, and our MSC-1 for DC motors. The stepper driver features variable speed, half step rotation, direction and power down mode, can drive most any stepper motor. Our DC driver features pulse width modulation control allowing full motor torque even at low speeds and can drive motors up to 50 VDC @ 10 Amps! Add our case set for a professional assembly.



SMD-1 Stepper kit.....\$24.95 MSC-1 DC motor kit.....\$24.95
CSMD SMD-1 case.....\$14.95 CMSC MSC-1 case.....\$14.95

SYNTHESIZED AUDIO GENERATOR



DDS (Direct Digital Synthesis) technology brings you a terrific audio generator at a fantastic price! Generates from 0.01 Hz to 50 KHz with five digit LED display of frequency. Sine and square wave output adjustable 0-5

volt p-p. Frequency selected by direct keyboard entry and with handy continuous tune tuning knob. Crystal controlled accuracy of 10 ppm and two memories for rapid frequency changes. Retire that jury-rigged old generator and treat yourself to the pleasure of using a new state-of-the-art SG-550!

SG-550 Kit.....\$199.95 SG-550WT assembled.....\$269.95

SHORTWAVE RECEIVER

Fantastic receiver that captures the world with just a 12" antenna! Can receive any 2 MHz portion from 4-11 MHz. True superhet, has smooth varactor tuning, AGC, RF gain control, plenty of speaker volume and runs on a 9V battery. Fascinating Scout, school or club project, provides hours of fun for even the most serious DXer. For the car, consider our shortwave converter. Two switchable bands (in 3-22 MHz range), each 1 MHz wide—tunable on your car radio dial. Add some interest to your drive home!



Shortwave receiver kit, SR1.....\$29.95
Shortwave converter kit, SC1.....\$27.95
Matching case set for SR1, CSR.....\$14.95
Matching case set for SC1, CSC.....\$14.95

AM TRANSMITTER

High quality, true AM broadcast band transmitter is designed exactly like the big commercial rigs. Power of 100 mW, legal range of up to 1/4 mile. Accepts line level inputs from tape and CD players and mike mixers, tunable 550-1750 KHz. Complete manual explains circuitry, help with FCC regs and even antenna ideas. Be your own Rush Limbaugh or Rick Dees with the AM-1! Add our case set for a true station look.

AM-1 Transmitter kit.....\$24.95
CAM Matching case set.....\$14.95

SCANNER CONVERTER

Tune in on the 800-950 MHz action using your existing scanner. Frequencies are converted with crystal referenced stability to the 400-550 MHz range. Instructions are even included on building high performance 900 MHz antennas. Well designed circuit features extensive filtering and convenient on-off/bypass switch. Easy one hour assembly or available fully assembled. Add our matching case set for a professional look.



SCN-1 Scanner converter kit.....\$49.95
SCN Matching case set.....\$14.95
SCN-1WT Assembled SCN-1 and case.....\$89.95

STEREO FM TRANSMITTER

Run your own Stereo FM radio station! Transmits a stable signal in the 88-108 MHz FM broadcast band up to 1 mile. Detailed manual provides helpful info on FCC regs, antenna ideas and range to expect. Latest design features adjustable line level inputs, pre-emphasis and crystal controlled subcarrier. Connects to any CD or tape player, mike mixer or radio. Includes free tuning tool too! For a pro look add our matching case set with on-board whip antenna.



FM-10A Stereo transmitter kit.....\$34.95
CFM Case, whip ant set.....\$14.95

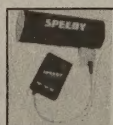
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Quit spending big bucks for replacement battery packs, rejuvenate and condition your batteries for peak capacity. Advanced circuitry has optimized discharge before charge to eliminate memory effect and to condition batteries that have been poorly cared for in the past. Quick charge rapidly brings battery to full charge in less than an hour—just 15 minutes for some types! And "top-off" charge mode squeezes every last bit of energy into each cell for the absolute most capacity. Switch-mode regulator controls constant current charge while being monitored by a negative delta-V system that cuts off the fast charge at the exact point of full charge—batteries are charged, not cooked! Charges NiCads or NiMH packs from 2 to 10 cells (easily expanded) and current capacities up to 10 Amp-hours. Runs on 12 to 15 VDC. Quit cooking your batteries, buying new packs, waiting hours for recharge, get a Dr. Ni-Cad today! Available in money saving kit form or wired and tested with case at a special price. Kit builders: add our matching case set for a snazzy finish.

DN-1 Dr. Ni-Cad conditioner/fast charger kit.....\$49.95
CDN Matching case set.....\$14.95
DN-1WT Fully assembled Dr. Ni-Cad with case.....\$89.95

SPEED RADAR

New low-cost microwave Doppler radar kit "clocks" cars, planes, boats, horses, bikes or any large moving object. Operates at 2.6 GHz with up to 1/4 mile range. LED digital readout displays speed in miles per hour, kilometers per hour or feet per second! Earphone output allows for listening to actual Doppler shift. Uses two 1-lb coffee cans for antenna (not included) and runs on 12 VDC. Easy to build—all microwave circuitry is PC stripline. ABS plastic case with speedy graphics for a professional look. A very useful and full-of-fun kit.



SG-7 Complete kit.....\$99.95

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PH-14 Dual Linear bargraph kit.....\$39.95 PH-15 Dual Log bargraph kit.....\$39.95
PH-16 Dual Semi-Log bargraph kit.....\$39.95 CPH Matching case set.....\$14.95

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SS-70 Scrambler/descrambler kit.....\$39.95
CSD matching case set.....\$14.95
SS-70WT Assembled
SS-70 and case set.....\$79.95

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Relive the radio past with a crystal set like your grandfather built. Uses genuine Galena crystal and catwhisker. Several different types of radios are built, including standard AM broadcast, shortwave and even WW II foxhole style. To compare modern semiconductor detectors, we include a diode for comparison. No soldering required and we even give antenna ideas. Radio for free, get it now before Clinton taxes it!

CS-7 Crystal set kit.....\$19.95

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Grab Touch-Tone numbers right off the air, phone or tape. A simple hook-up to any radio speaker or phone line is all that is required to instantly decipher touch-tone phone numbers or codes. A 256 digit memory stores decoded numbers and keeps its memory even in the event of power loss. An 8 digit LED display allows you to scroll through the memory bank to examine numbers. To make it easy to pick out number groups or codes, a "dash" is inserted between sets of digits that were decoded more than 2 seconds apart. A "central-office" quality crystal controlled decoder is used allowing rapid and reliable detection of numbers at up to 20 digits per second! For a professionally finished look, add our matching case set. Start cracking those secret codes tomorrow with the Tone Grabber!

TG-1 Tone Grabber kit.....\$99.95 CTG Matching case set.....\$14.95
TG-1WT Fully assembled TG-1 and case.....\$149.95

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CB-1 Voice recorder kit.....\$59.95 CCB Matching case set.....\$14.95

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QLF

by Wayne Green W2NSD/1

Are You Listening?

That loud noise you hear is opportunity knocking. Unless you've already chosen a high-tech career path, your interest in amateur radio can be the ticket to a fascinating and fun career... and I don't mean just as an electronic or communications engineer. Amateur radio is fairly unique as a high-tech hobby which rewards you with fun and excitement as you are learning.

Like over 80% of the hams before 1963, I got hooked when I was a teenager. A survey by the ARRL showed that 50% of all new hams in those days were either 14 or 15 years old. I was 14 and just entering high school.

Sure, you can take the low road. I admit that I memorized the ARRL Q&A book when I got my license. I read all I could, built a ton of gadgets, and went on the air without a license for a couple years. By then the die of life was cast for me. My interest in hamming got me into a technical university, thus saving the country from winning another lawyer. And then, when WWII came along, I enlisted in the Navy in 1942 as an electronic technician. The Navy electronics course was superb, turning me in a few months into an expert in radio, electronics, radar, and sonar. From 1943-1945 I made five war patrols on a submarine and then came back to teach at the Submarine School in New London (CT).

Now, about you. Pay attention to your old Uncle Wayne. Just because you've sneaked your way into the hobby by memorizing a Q&A manual, there is no reason to stop learning everything you can. Get some books and learn how antennas work. Learn about transistors and tubes. But most important, learn the fundamentals of electricity. Learn about logic circuits and ICs. Get your workbench set up so it's comfortable to use and well-lighted, invest in some good test equipment and tools, and start with some kits.

Explore every facet of this fantastic hobby you can. Don't just flip over the ham magazine pages on things you're not yet involved in, read about 'em. You can't do everything at once, but you can pick 'em one at a time and get cracking. It's surprising how easy it is to become an expert in some aspect of hamming. We've still got plenty of room for pioneers.

Our present-day pioneers are pushing for faster and faster packet on the HF bands. They're trying out spread-spectrum communications. They're messing with data compression for video. They're sending eentsy TV cameras with radio transmitters up in balloons. They're on 2m sideband bouncing signals off aurora attacks. They're having a ball with the ham satellites. But most of all, every step of the way they're learning, and there isn't one thing they're doing where you couldn't be helping.

You can help by learning, doing, and then teaching. How about a series of articles for

Radio Fun on your specialty? Part of what you owe to amateur radio is to get as many hams as you can interested in what you've learned and are having fun with. Under the guise of a ham magazine editor I've been selling fun and education for years. One of my great-grandfathers founded Oberlin College, so it may be a genetic fault I inherited. I've still got his old dining room table and chairs. Three American presidents visited him and ate at it.

Maybe you'll get interested in direction finding. This is great for foxhunting, and then for finding repeater jammers, unlicensed ops, and other such troublemakers. Or you may get all involved with seeing what you can do on 6m. It's opening every now and then, providing all sorts of short-skip contacts. How about ducting contacts on 2m?

As you learn more of the fundamentals you're going to get some surprises. For instance, you'll find that it doesn't take long before you're at the end of what we really know. We're not sure what electricity is or why it works. We know a lot about making and using it. Then you'll find that the same is true about most of the real basics. We don't know why gravity exists, or even inertia. We've got some busybody scientists taking apart the atom, but they've run into a terrible mess of smaller particles or waves or something. My interest in cold fusion has got me trying to sort out baryons, mesons, maybe 10 flavors of quarks,

come in for a show-and-tell session. Run code classes. Get the DXers to show their newest rare QSLs. How about doing a club video on what your members are doing and using it to help recruit kids? Maybe you can form club auxiliaries in the local schools. I guarantee the kids will eat it up.

The more I look into what's going on in science today, the more opportunities for pioneering I see. The old-time physicists are fighting a losing battle against the cold fusion phenomenon. Yet here's a new technology that just about any kid can set up and demonstrate on the kitchen table in one day. All it takes is two nickels and a glass of plain tap water with some potassium carbonate in it (3:1) and a couple thermometers. First you calibrate your experiment with a resistor in the electrolyte. Take a 10-watt resistor and run 10 watts through it for two or three hours and measure the temperature in the liquid and outside the glass. Use a small motor to stir the liquid. Then put in your two nickels, held by a couple paperclips (epoxy the clips to keep the iron from contaminating the liquid), and run 10 watts through it. You'll find that you're getting about 40% more heat. Now where did that come from?

The more you read of science, the more you'll find yourself amazed at how reactionary professional scientists are. I don't believe you can find one major scientific breakthrough in any field where the establishment didn't ridicule and harass the pioneers. Yes, you get arrows in your back as soon as you step out in front.

Einstein was ridiculed for his theory. So was Max Planck for his quantum theory. The Wright Brothers were ridiculed and branded liars when they said they'd flown a heavier-than-air craft.

You've probably heard about talking to your plants to help them grow. Snicker, nudge... right? You're snickering only if you are ignorant, and that includes some prestigious scientists. Again, a simple home experiment will show you who's right and who's the fool. Just take two paper cups, fill them with identical dirt, put a mung bean in each, add identical quantities of water, and put the two cups on the window-sill so they'll get sun. Now, completely ignore the left cup and concentrate several times that day on the right-hand cup. Send it your sincere love. Wish it to grow tall and healthy, and never mind the snickers. This is a scientific experiment. In a day or two when the sprouts come up you'll see that the right-hand bean is significantly taller. Probably at least

twice the size of that poor little left-hand cup bean. Does this mean that we can communicate with plants? Yep. Now maybe you'll want to start reading about that. There are some most interesting books. The next thing you know you may be experimenting with human cells and showing how they are communicating instantly over any distance with each other.

I've found that every branch of science is strewn with anomalies which beg for research, but which are sneered at by the "experts" in the field. We may have run out of new countries to explore, but we've just barely started in science. That's where we need pioneers, and amateur radio is a great entry for learning. But please, don't get bogged down like those old-timers at the radio club with rag-chewing and chasing QSL cards for some stupid award. And if I hear you on the air repeating a mindless formula QSO I'm going to retch. Yes, it's a challenge to keep your contacts fresh and interesting. Well, as Forrest Gump said, "Stupid is as stupid does."

Now, how soon will I be seeing some pictures of your plant experiments? Your 10¢ cold

fusion experiment? Pictures of the kids you've sucked into getting ham tickets? Club newsletters from your new ham club? A list of books you recommend other hams read who want to pioneer in science. Have you subscribed to the *Megabrain Report*? Have you any idea of how little psychiatrists and psychoanalysts really know about repairing the mind? These guys are mostly in the 1800s. Wait'll you find out about how "medical science" is not just ignoring, but is actively fighting medical discoveries and rediscoveries. Sure, doctors grudgingly admit that the mind triggers all illness, yet hardly any of them are treating anything but the resulting symptoms. Maybe the wrong people are in the mental institutions. We used to call them insane asylums or nut houses. Well, the nuts are in control.

All that stands between you and progress is some knowledge, so learn first, then teach. Oh yes, buy a used Mac PowerBook and Laserwriter and get started with a newsletter so you can help infect more people with knowledge... and excitement.

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The Mistakes New DXers Make, Part 1

How to work DX when you've never done it before.

by Steve Katz WB2WIK/6

Many *Radio Fun* readers are newly-licensed and eager to get working DX on the HF bands. High-frequency (HF) long-distance contacts are commonplace on all the amateur bands from 3.5 through 29.7 MHz, but *real* DX means contacting foreign countries, especially ones not adjacent to your own. For American amateurs, VE (Canadian) and XE (Mexican) contacts are usually so easy to make they really don't qualify as "DX," so let's talk about the real stuff—contacts with foreign countries that are on the "100 Most Wanted" list.

Real DX

Of the hundreds of countries available to work on the ham bands (the number of countries changes almost monthly, but hovers around 325 or so), the U.S., Japan and the Russian republics hardly qualify as real DX for anyone because we are so numerous. But for the newcomer, each new country is DX until it has been "worked" (contacted) and confirmed by receipt of a QSL card. And DX has different meanings to different subgroups of amateurs: A terrific DX contact on 2 meters might mean working an adjacent state, especially if it is hundreds of miles away or over a range of mountains!

But the HF DXer spends more time and energy searching for new "rare" ones to log and trade QSL cards with. If you listen to 10-meter SSB between 28.300 and 28.500 MHz, you'll hear a lot of would-be DXers trying to work stuff. This is because this is Novice turf, where newly-licensed and recently-upgraded hams are trying their wings for the first time.

In this predominantly Novice/Tech-plus band segment, (the only place where Novices and Tech-plus hams have any HF DX voice privileges), I've heard Americans calling CQ nearly on top of DX stations already in QSO; hams calling DX at a speaking rate of about 10 words per minute, using ridiculous phonetics and poor enunciation; stations calling DX a few hundred Hz off the correct frequency, probably because they left their "RIT" on by mistake; and folks asking DX to repeat information over and over again because they weren't

concentrating hard enough. We forgive these poor operators for their sins because we know so many of them are brand-new at this game and have to work their way up the learning curve.

Doing It Right

If you want to sound more polished on the air right from the start (sounding more experienced and knowledgeable will open doors for you), here are a few tips you can use to put your best foot forward with your first transmission.

First, always *listen* to the band for a while before pushing that transmit button. Tune around, get a feeling for what condition the band is in and who's where. Who is working what? If you hear a stateside ham working some interesting DX, before calling the DX too, ask yourself: "Do I really hear the DX station well enough to make a contact? If he answers me, will I understand what he's saying?" Many DX QSOs are very brief, especially contacts with the "rare ones" who seem to always have "pileups" (lots of people calling at once), so you may not have to copy the DX 100% solid to make a contact. But you should at least be able to copy his callsign and other important data (name, QTH, QSL route, etc.). If you can't hear him, it really doesn't matter much if he hears *you*, because you'll never complete a contact.

If you hear a "rare one" making lots of contacts quickly, get into the pace of his operating. If he gives his callsign only once every few minutes, make sure you write it down so you won't have to ask him what it is. If he gives some other station his QSL information—e.g. "QSL via the bureau," "QSL via W6GO," "QSL via CBA" (which means "Call-book Address"), "One green stamp please" (which means please send a U.S. \$1 bill with your QSL, along with a self-addressed

envelope, to cover the cost of his return postage), "3 IRCs PLS" (which means send three International Reply Coupons, available at your local Post Office, along with a self-addressed envelope), or whatever—write *that* information down, too, so if you do make a contact you'll be all ready to properly log and confirm it. It pays to have all this stuff written down *in advance* of actually making your contact. Listening to the DX make other contacts first is the best way to "land" it for yourself.

Second, listen some more. When I referred to the "pace" of the DX station's operating in the last paragraph, I meant how quickly he is working others, what order he's taking them in, what info he requests from each station. If the DX station is trying to "run" stations quickly (make lots of contacts in rapid succession), don't offer him your name, exact QTH, a weather

report, a description of your rig or anything else that other folks haven't given him. A simple, "Thank you. You're 5-9 in California. Over," is quite sufficient in these cases. If you hear that the DX isn't in so much of a hurry and asks everyone else for their name,

county, or whatever, be prepared to do as others before you have done and give it to him. In this case, you'd say, "Thanks a lot for the report. You're 5-9 here in sunny Los Angeles, California. Name here is Steve. Look forward to your QSL. Over," or something like this. This transmission still only takes 10 seconds, but is more "chummy" than a quick signal report and state.

If the DX is making most of his contacts in some part of the country other than yours, there's a good chance the propagation favors that area and you won't make contact, anyway. I've called DX stations that were 30 dB over S9 here, using legal limit (1500 watts output) transmitting power, and on some occasions have not gotten through because propagation favored somewhere else and the DX was hearing *those* stations 60 dB over S9!

It happens. Luckily, there are other times when I've heard DX barely out of my noise level (like S2), called them with 50 watts, and have gotten right through on the first call. When that happens, it's a good bet the DX didn't have any propagation to anywhere else in the world, so my call might have been the only one he heard. It's the luck of the draw.

Next, don't use phonetics unless your call is so confusing without them that nobody could possibly understand it, or unless brief phonetics add no more length to your callsign when sent. For example, "Whiskey Echo Six Alpha" is 7 bits long (seven syllables to pronounce), while "WE6A" is 6 bits long (six syllables to pronounce). Since the phonetics add almost no extra length to the transmission, there's no harm in using them. But to say, "Kilowatt Six America Brazil Colombia" (14 syllables), when "K6ABC" is only five syllables and will probably get through much better, is ridiculous. Don't fall into the phonetic trap. Use phonetics when absolutely necessary, and *then* make them as simple as possible. The Army phonetic list (Alpha, Bravo, Charlie, Delta, Echo, Foxtrot, Golf, etc.) is pretty good, but some DX stations more easily recognize names of countries or famous cities, if well-enunciated and not too long.

Practice your diction off the air using a tape recorder. This is a terrific recommendation for phone (voice) operators. If you read a few pages from a book into a tape recorder and play it back for yourself, you'll get a good idea of what you really sound like on the air. If you don't like what you hear, it's within your power to change it. Practice clear enunciation and diction. Don't slur syllables or words. Pronounce crystal-clear S's, razor-sharp Z's, and rock-hard K's. Keep practicing until you like what you hear when you play the tape back.

Next, study world maps, world atlases, globes and so forth to get a feeling for world geography. Know the popular DX prefixes, and study the prefix/allocation charts to become familiar with what is and what is not a real DX callsign. If you have an HF-band beam

Continued on page 6



Photo A. Look on a map to see what you've worked! The author points to Fernando de Noronha in the South Atlantic, where the ZY0FX QSL card came from.

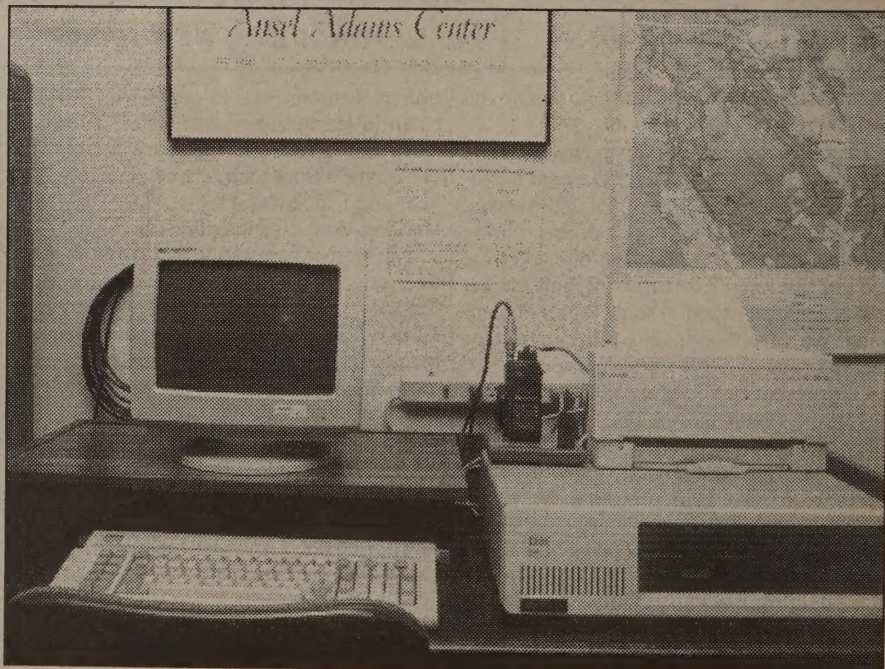


Photo B. The author's packet station isn't much: a PC/XT with a 1-1/2 watt, 2 meter "handie" doing the RF work.

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letters



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Aurelia Anderson KC6HXS, Petaluma CA The smiles and the tears started when I read "The Spark" by James L. Griffith WA7NDD in the July 1994 issue.

I was an eight-year-old girl when a friend of my brother came to the house one day. In his hands was a metal chassis with tubes and things, with a cord hanging from it. Well, I had looked into the back of our big old (1930s) Zenith floor-model radio on a few occasions and figured this must be something of the same, except smaller. Even though my brother was just mildly interested, I had to stick my nose into this strange contraption. Needless to say, his friend was not interested in explaining to an eight-year-old girl what he had accomplished. So much for that.

After a few years, that old Zenith just decided to quit. The transformer had had it. My dad took it down to the local radio fixit shop and was told the sad news. Money was limited and so was the availability of the transformer. On the counter sat this plain-looking table-model radio. I think it was a Messenger (?), from a kit. It worked just fine except that I could never get anything on the other band. Then a neighbor dropped by and said, "Why don't you put an 'aerial' on the back?" Well, needless to say, here entered the world of shortwave for my brother and I. We were, and still are, hooked on shortwave.

I wanted more. I read up on electronics and everything I could find. The one thing I needed the most was an "Elmer" or "Elsie," but that never happened. I discovered "hams," but it took me 25 years on my own to reach my way to an Advanced license. I'm not through. Too bad it took me so long.

Matthew Steger N3NTJ, Erie PA The Young Operators International Club (YOP) is an international club for anyone under 40 years old who is interested in amateur radio, shortwave radio, or just listening to the radio as a hobby. I am the United States representative for the club and we are trying to get some new members. Our president is Andy Trubachov UA3PIP, from Russia; our secretary is Lee Volante G0MTN from the U.K.

If you are a teacher involved with a school radio club or group, please take some time and consider the great things that can be learned and the new friends one can meet via amateur radio. Wouldn't radio be a great adventure to teach to your students? Whether you like the technical aspect of radio or just like the idea of communicating with people, amateur radio is a great hobby. A licensed operator can talk to the astronauts when they are in space, simply talk to people from all over the world, or help out during a disaster. I helped out during the Los Angeles earthquake this past winter and actually talked to victims a few hours after the event occurred.

Please become a member of our great club. If you are a school group and just want a group membership, you may sign up under your club's name. The one-year fee is only \$5 and that will give you four newsletters a year and any other other goodies that we may throw in during the course of the year.

The club will be able to receive ARRL (American Radio Relay League) sponsorship when we get sufficient membership. [For an information sheet, contact Matthew Steger N3NTJ, 1137 Mission Dr., Erie PA 16509.]

John H. Grow, Greenfield Park, Quebec, Canada Wayne. I have been a reader of 73 since 1973, since your article on your visit to Jordan. Your editorials are great, and I'm trying to learn from them. Even more important was your book *Declare War* (I ordered two copies). I recently subscribed to *Radio Fun* and "Cold Fusion".

I do not have my license yet, but I have finally decided to get my ticket. My wife is also working on her license. I have a small company which is trying to export industrial electronic products and technology. Things do get very rough sometimes, and the future is unknown. Having worked for multinationals like Siemens, Apollo Computer and Hewlett Packard, I have seen waste at every level. Waste, as lost human potential, lost opportunities, lost friendships, lost customers and lost markets. Change is their worst enemy; change is the green light for every entrepreneur to do something. As hard as it is, day in and day out, not making a six-figure salary like I have in the past, and changing my lifestyle to suit my present income, I find that I have the time to explore other areas of life which I did not have before. I started to do volunteer work at the local high school and set up a series of career days, where speakers are invited to talk about their profession. At the same school, I'm setting up a computer laboratory in memory of two close friends who died this year.

At the same school, I would like to set up an amateur radio club, with help from some amateurs in the area. I have found out the hard way that people are very good at talking, but when it comes time to help out, every excuse in the world is used. Nevertheless, commitments are commitments are commitments, and everyone should try to honor them. It is always the same people doing all the work.

Do you have any updates, or a newsletter to follow *Declare War*? Are there any plans to release all of your editorials since Day One?

Sure, John, I've published 20 16-page Updates to the book so far, with no end in sight. A 10-pack of 'em is available for \$5 postpaid; all 20 for \$10 postpaid, for the extremely adventurous. With some reader pressure I'll edit the Updates into a book. If I wasn't so ridiculously modest, I'd mention that these are packed solid with creative solutions to many of our most serious social problems.

.... Wayne

RF

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The Mistakes New DXers Make

Continued from page 4

antenna, use a Great Circle map, rather than a "flat map," to know where DX is really located compared with your station. If you live in the U.S., there's a very good chance that the shortest path to the "other side of the world" will be north, over the Arctic pole. This is the path that will ordinarily produce the strongest signals (but not always); however, the polar paths often produce rapid flutter and distorted-sounding signals. This phenomenon is due to geomagnetic disturbances predominant in the polar regions. The distortion created by the path does not make signals unworkable, but it might just make them a bit harder to understand. Practice copying signals coming from "over the pole" until you find them easy to read. It takes practice.

Practice your *timing* when calling DX stations, especially when calling in a "pileup." If you begin calling the second the DX station stops transmitting, you aren't likely to get through. But if you call a few seconds later, after the "big guns" (powerful stations) have already called, your call sign might be the last one the DX station hears, and yours might be the one he answers. But if you wait too long, you'll have missed your opportunity and the DX will already have responded to someone else. In addition to using precise timing, another "trick" is to call the DX just slightly above or below his frequency (purposely), to make your voice sound a bit different from everyone else's. This does not represent "split" operation; that's another subject.

It pays to make friends with a few local, established, "big-gun" DXers in your neighborhood. Most neighborhoods have at least one or two stations in this category. (By neighborhood, I mean your town, or a nearby town, close enough to meet another ham in person

and get to know them.) Not only can you learn a lot from these folks, but they can help you out in pileups! For example, say you hear your local DXer big-gun buddy John working a DX station you need. Just before he signs off with the DX, you break in very quickly and tell your buddy (with your ground-wave signal, that he hopefully hears), "I want 'em, buddy! KD6EWT!" Say this fast, so your friend won't miss what the DX is saying. If you're lucky, before he signs off with the rare one, your friend will say, "Will you please listen for my friend KD6EWT? He's a neighbor of mine, running

QRP." If you're lucky again, the DX will hear that request and say, "Sure. KD6EWT are you there? This is T77C." Bang! The window is open for you! You still may or may not make the contact, but at least the way has been paved for a possible rare one.

A word of advice on this, though: *Don't* try this trick when the DX is running a pileup in his own specific fashion, by making lists of calls he's already heard and answering them one at a time, or by running through the call districts one by one. Some DX stations get pretty peeved at us calling out of turn, using trickery to make a contact, and so forth. If those stations are using computer-logging (as many "DXpeditions" do) or have good memories, they can "blacklist" you so you will not have a confirmed QSO with them, no matter what!

DX Nets

The DX bands, especially 20 meters, contain regularly scheduled DX nets organized for the purpose of making DX contacts more readily available. To make a DX contact on a net, you must first "check in" with the net

control station, usually a U.S.-based operator. The DX station is essentially in continuous contact with the net control, and others participating in the net announce their callsigns in turn to express their desire to contact the DX station(s). Net control then reads back the calls he's heard, one by one, to give those operators a chance to make

the DX contact. You still must make the contact on your own, by giving the DX station a call and report (usually brief, like "3Y5B this is WB2WIK, 5-9 in California, over"). If the DX station hears you, he'll reply directly to you, like "WB2WIK

5-9." Net control will usually follow with a comment, like "Good contact." Then net control goes on to the next station on his list.

I very rarely use DX nets myself, but they're legal and contacts made this way *do* count. Just be sure before you try checking into a DX net that you actually hear the DX station(s) you want to work—it's a waste of everyone's time if you don't.

DX Packet Cluster Networks

These are great! If you are equipped for VHF packet work (and packet-only TNCs are readily available for about \$100 or so, sometimes less on the used market; with the TNC, all you need is a computer or a "dumb terminal" and a VHF rig—usually 2 meters—and you're ready to go!) ask around about whether you have a local VHF Packet Cluster in your area. If you're in or near any major metropolitan area, you probably do. Here in Southern California, we have the Southern California DX Packetcluster System, which has 12 "nodes" covering almost every square mile of this highly populated region. The local "nodes" are on 2 meters, and its local "backbone" (com-

munications between nodes) is on 70 cm. It also has an HF "gateway" so we can see DX listings from other parts of the country. Many areas have a similar system.

With a DX Packetcluster System you can see and make DX listings 24 hours a day, every day of the year, to find and list DX available on the bands. It's like having a second operator in the shack to search all the bands looking for DX for you! Most big-gun DXers are members of such systems and will be the first to work the rare ones. Once they've made the contacts, they "list" them on the packet-cluster system, indicating the time and frequency of each contact made. The listings are rebroadcast by the local nodes almost immediately, giving you nearly real-time DX-searching data. Many articles have been written on this subject, so I won't go into more detail here.

QRP Etiquette

If you operate mobile or QRP (5 watts or less), don't be afraid to identify this way: Some DX stations really do have hearts and listen harder for mobiles and QRP stations. When I run 5 watts (and I do, now and then), I always sign "WB2WIK QRP" when calling DX. Sometimes the DX station will actually reply, "Everyone please stand by. The QRP station go ahead now." Eureka! A QRP DX QSO right in the middle of a pileup! But don't lie about it. Use the "mobile" or "QRP" signal only when you're really doing it.

Next Month

Next month we'll round out our primer on the DX world with lots of operating tips, and a discussion of split operation. We'll take a look at which bands are best for contacting which countries, and give you techniques for collecting those rare QSL cards. Until then, happy DX! **RF**

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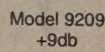
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Third Auction Set

According to *Electronic Engineering Times*, the FCC has scheduled a third wireless spectrum auction for October 26 for regional licenses for two-way paging and messaging. These are part of the narrowband PCS (personal communication service) airwaves which the government began selling earlier this year.

The two earlier auctions sold paging and interactive television channels for an estimated \$830 million, but as of this writing, more than two dozen bidders have failed to make their license down payments.

Still to come—separate broadband PCS auctions. A date for that to commence is still yet to be announced. *TNX Electronic Engineering Times*, Issue #811, August 22, 1994.

Superconductivity Strides

A Japanese researcher has discovered a method for building superconducting wires of atomic dimensions, according to *Electronic Engineering Times*. Yositaka Yosida of Iwaki Meisei University's Department of Material Science stumbled on the discovery while experimenting with caging rare earth dicarbides in large buckminsterfullerene molecules. Yosida found that elongated carbon buckytubes containing tantalum carbide—a superconductor—are formed in electric arcs.

The result of these experiments is a superconducting wire with a protective coating of carbon. Superconductivity is an emerging technology in which electricity can travel through superconducting materials which exhibit zero resistance.

In a related development, a switched 32-channel filter bank designed to eliminate interference and jamming in microwave systems has passed its first major test by the U.S. Air Force, the first giant step toward the installation of HTS (high temperature superconducting) devices in the communications and radar systems of military aircraft. The filter bank is designed and manufactured by STI, Superconductor Technology, Inc.

The STI filter is seen as a big leap in technology. Today an aircraft can filter only one or two signals, which is inadequate in dense signal environments like those in the Gulf War. Tests of STI's optically-switched 32-channel filter bank found that it successfully screened all but the target signal. Other potential beneficiaries of the technology would include cellular telephone networks. *TNX Electronic Engineering Times*, August 15, 1994.

AuH₂O

Former Senator Barry Goldwater K7UGA appeared on the "Ham Radio and More" broadcast radio talk show recently and was "sensational as usual," according to host Len Winkler KB7LPW. The venerable republican lawmaker answered callers' questions with topics ranging from MARS to SDI military hardware. A lot of praise was heaped on the former senator from all over the country. Winkler said.

Goldwater continues to be a staunch supporter of the no-code license, and says that since the code is so outdated, and not so widely used in the military today, he believes the time has come to do away with the code requirements, even though he frequently enjoys operating CW himself. He also says our ability to handle communications during times of national emergencies is justification for the amateur radio service to exist. Goldwater is opposed to licensing fees for amateurs.

"Ham Radio and More" can be heard Sundays at 6:00 p.m. Eastern on the Talk America Network in 23 cities and via Spacenet 3, transponder 9, 6.8 MHz audio. *TNX Westlink Report*, No. 677, August 2, 1994; and KB7LPW.

...or am I just getting older?

Youth Movement—On the left you see the world's youngest ham, Connor McCann, carrying on a high speed CW QSO. Well, he isn't really licensed yet, but his first utterance was "dah dah", according to his grandfather, Fred Doob AA8FQ. On the right, one of the youngest hams in Columbus, Georgia, 12-year-old Josh Dally KE4GRJ, is seen working an eight-hour shift, assisting the Red Cross Disaster Services with emergency communications during some of the worst flooding in memory there. What a way to spend the Fourth of July! *TNX* Fred Doob AA8FQ and Joe Owen KO4RR. (Right photo by Miss Billi KD4CPB.)



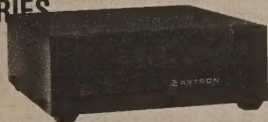
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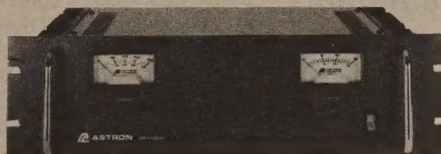
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SL-11A	• •	7	11	2 5/8 x 7 1/2 x 9 3/4	12
SL-11R	• •	7	11	2 5/8 x 7 x 9 3/4	12
SL-11S	• •	7	11	2 5/8 x 7 1/2 x 9 3/4	12
SL-11R-RA	• •	7	11	4 1/4 x 7 x 9 3/4	13

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MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RS-4L	3	4	3 1/2 x 6 1/2 x 7 1/4	6
RS-5L	4	5	3 1/2 x 6 1/2 x 7 1/4	7

• 19" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RM-12A	9	12	5 1/4 x 19 x 8 1/4	16
RM-35A	25	35	5 1/4 x 19 x 12 1/2	38
RM-50A	37	50	5 1/4 x 19 x 12 1/2	50
RM-60A	50	55	7 x 19 x 12 1/2	60
• Separate Volt and Amp Meters				
RM-12M	9	12	5 1/4 x 19 x 8 1/4	16
RM-35M	25	35	5 1/4 x 19 x 12 1/2	38
RM-50M	37	50	5 1/4 x 19 x 12 1/2	50
RM-60M	50	55	7 x 19 x 12 1/2	60

MODEL	Colors Gray Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RS-3A	• •	2.5	3	3 x 4 1/4 x 5 3/4	4
RS-4A	• •	3	4	3 3/4 x 6 1/2 x 9	5
RS-5A	• •	4	5	3 1/2 x 6 1/2 x 7 1/4	7
RS-7A	• •	5	7	3 3/4 x 6 1/2 x 9	9
RS-7B	• •	5	7	4 x 7 1/2 x 10 3/4	10
RS-10A	• •	7.5	10	4 x 7 1/2 x 10 3/4	11
RS-12A	• •	9	12	4 1/2 x 8 x 9	13
RS-12B	• •	9	12	4 x 7 1/2 x 10 3/4	13
RS-20A	• •	16	20	5 x 9 x 10 1/2	18
RS-35A	• •	25	35	5 x 11 x 11	27
RS-50A	• •	37	50	6 x 13 3/4 x 11	46
RS-70A	• •	57	70	6 x 13 3/4 x 12 1/2	48

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4 1/2 x 8 x 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 x 9 x 10 1/2	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13 3/4 x 11	46
RS-70M	57	70	6 x 13 3/4 x 12 1/2	48

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts • Current limit adjustable from 1.5 amps to Full Load

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
	@13.8VDC @10VDC @5VDC	@13.8V		
VS-12M	9 5 2	12	4 1/2 x 8 x 9	13
VS-20M	16 9 4	20	5 x 9 x 10 1/2	20
VS-35M	25 15 7	35	5 x 11 x 11	29
VS-50M	37 22 10	50	6 x 13 3/4 x 11	46

• Variable rack mount power supplies

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
VRM-35M	25	35	5 1/4 x 19 x 12 1/2	38
VRM-50M	37	50	5 1/4 x 19 x 12 1/2	50

• Built in speaker

MODEL	Colors Gray Black	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RS-7S	• •	5	7	4 x 7 1/2 x 10 3/4	10
RS-10S	• •	7.5	10	4 x 7 1/2 x 10 3/4	12
RS-12S	• •	9	12	4 1/2 x 8 x 9	13
RS-20S	• •	16	20	5 x 9 x 10 1/2	18
SL-11S	• •	7	11	2 5/8 x 7 1/2 x 9 3/4	12

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

Digital HF Modes

by Jeff M. Gold AC4HF

I love ham radio. Every time I get used to one aspect of the hobby I find something new and exciting to try. I have recently spent time exploring the HF digital modes such as PACTOR, AMTOR, RTTY and HF packet. I quickly dismissed HF packet. It was too slow and I never experienced much success with it. I have had a great time playing with the other modes and they are fast becoming my favorites.

You come across a different type of person on the digital modes. I find the hams I work like to rag-chew more than just give a signal report; this includes DX stations. Even when working contests it isn't uncommon for the ham on the other end to stop and talk. I find I like to be able to learn more about the people in foreign lands than about the type of rig they are running and what the weather is like. Soon after my eight-year-old son upgraded to General he was on AMTOR. He was talking to a guy in England. They sat and exchanged jokes for over 40 minutes. The digital modes still aren't crowded so you can work DX or the US quite easily.

To experience the fun and excitement of these modes you will need to have some idea of what they are and what type of equipment will be necessary. You really don't need to go to a great deal of expense to try out these modes—you might already have most of the necessary components in your shack.

Equipment

Most HF transceivers can handle the digital modes. Some of the older equipment may have problems if the relays are too slow to handle the rapid changeover from transmit to receive. My old Kenwood 820S tube rig had loud relays but did a fine job with the digital modes. When using one of the more modern solid-state transceivers you will need to make sure it has a 100% duty cycle; this means it must be designed to handle the longer key-down periods necessary for the digital modes.

You will need to either buy a new or used multimode TNC (sometimes referred to as a multimode data controller). I purchased my used AEA 232MBX before PACTOR was developed, but was able to buy an upgrade that allows it to handle the new modes. The upgrade involved a simple switching of two internal chips. The earlier 232 models required the purchase of an additional circuit board in addition to the chip swapping. Some of the Kantronics KAMS are also upgradeable.

The new AEA 232MBX, the MFJ 1278B and the Kantronics KAM Plus all come with built-in PACTOR capabilities. Each brand has its advantages and disadvantages. They all have many similar features, but each one offers different capabilities. I believe if you use any of them you will be happy with the results. Each brand has its own following.

If you have a transceiver and a TNC, the next thing you will need is a device that will allow you to enter the digital data on a keyboard and monitor it on a screen. While you are watching what you are typing, the device needs to be able to communicate with your TNC. I started off with a "dumb" terminal. They are referred to in this manner because they don't possess microprocessors capable of a number of tasks. They can work fine. I found that when I really started to use the digital modes I wanted to be able to do things that weren't possible using the dumb terminal.

The next step up is to use some brand of personal computer to go between you and the

TNC. The use of this smarter device makes it easier and more fun to operate the digital modes. I didn't have much money when I was first ready to progress to a computer-driven setup. I looked around and found an older model XT compatible in perfect shape, with a paper-white VGA monitor and a 20 megabyte hard disk, for \$225. This was in about December 1992. This past weekend I was at our local hamfest. I saw two similar PCs go for \$75 each. These are considered "old" technology computers and won't run any of the new Windows software, but the software I run for ham radio works fine. I love the keyboard and screen on my machine and find them to be the two most important features for a computer that will be used mostly for typing on the keyboard.

Using a computer allows you to use the digital modes more easily. The computer software makes the changeover from transmit to receive a lot easier and allows me to program in certain text files. One of the files that you program in is called your "brag" file. This is a short description of your station equipment. Most software allows you to program in five to 10 different files, and comes with some commonly used ones already programmed in. Another nicety that software provides is logging. This takes away some of the part of ham radio I enjoy the least: the paperwork.

With one push of a button I can call automatic CQ that will send a CQ in the proper format and then, if no one answers it, it will repeat the CQ after a period of time that I specify. If someone answers my call it automatically sets up the connection and enters the person's call into my log area. When it is time to issue the changeover sequence I merely press one function key and it sends *Their call de AC4HF*.

What is this Digital Stuff?

The TNC is a special type of modem. The word modem comes from the two functions that it performs: *mod*-ulation and *dem*-odulation. You type information on your keyboard and the modulation part of the unit converts the information which is sent from the computer in digital form into analog for your transmitter to send. On the other end the analog signal goes through a receiver and is demodulated by another modem into digital information that appears as text on your monitor. The two methods used to modulate the transmitter are frequency-shift keying (FSK) and audio-frequency-shift (AFSK).

Some transceivers have built-in FSK. With FSK, the transceiver has the ability to generate a constant output power signal which typically has a 170 Hz shift between one or two existing conditions. One of the frequencies of the carrier is called *Mark*. The other frequency is called *Space*. The difference in frequency between these two is the 170 Hz frequency shift. The two conditions are equivalent to the binary 1 or 0 states that computing devices use to represent information in binary form.

Well, that is what is going on. You don't

need to do anything about it. Your transceiver automatically handles this when put into this mode, and the TNC knows what to do with the information. There is an advantage to using FSK over AFSK: When using FSK you are able to use additional CW filters if your rig is equipped with them.

Audio-frequency-shift-keying is handled by the TNC. Using this mode you connect your TNC through the mike connector (or accessory plug on some transceivers). In this mode the carrier is still constant but the audio tone of the signal is shifted in frequency. I have been using this for a number of years and it works well. You can use either method for RTTY, ASCII, AMTOR and PACTOR.

Radio teletype (RTTY) has been around for quite a while. Early hams used surplus teletypewriter machines that were very slow. As microprocessors became more common and less expensive they took over this area of ham radio communications. RTTY is sometimes called Baudot for the code used to generate the standard set of symbols (letters and numbers) that are sent over the air.

ASCII is similar to RTTY. ASCII stands for the American Standard Code of Information Interchange. This is a code used to describe all the letters of the alphabet, numbers and symbols. It was designed to allow different types of computers to share information. The way

this mode operates is similar to RTTY but the codes used to represent the different letters and numbers are different. There doesn't seem to be a lot of people operating in this mode.

With these types of digital communications, bad band conditions cause the TNC to have wrong information to demodulate. This

can mean some strange or wrong characters appearing on the receiving station's monitor. AMTOR was designed in order to make communication more error-free. AMTOR stands for Amateur Teleprinting Over Radio. With AMTOR you actually create a "link" between the sending and receiving stations. The signal is sent and then checked on the other end and printed to screen if correct. Once this occurs the receiving station's TNC sends a signal over its transmitter saying the signal was received OK, please send more information. If errors are detected by the receiving station's system, it sends a message requesting that the information be transmitted. Each station takes a turn as the sender or receiver. When one station is done with his message he presses a key sequence that tells his TNC to change from the transmit to the receive mode and send a signal to the other station to change over. The use of computers and software make this very easy.

PACTOR is a new digital mode. It was developed in Germany by Hans-Peter Helfert DL6MAA and Ulrich Strate DF4KV. The intention of this mode was to incorporate some of the more desired features of both AMTOR and packet and add some extra features. Some desirable features such as good error correction and faster response time were programmed into this mode. When band conditions are somewhat poor, AMTOR can be painfully

slow. There can be a long wait between the time you type something and the time the other person gets to read it. PACTOR adjusts itself automatically to the band conditions. If the band is feeling well it will run at 200 bps (bits per second). If the band starts to go it will adjust itself down to 100 bps, which still isn't too bad.

Software

The TNC manufacturers each offer software to go with their products. AEA sells PC-Pakratt II for DOS machines, PC-Pakratt for Windows, MacRatt for the Macintosh and Com-Pakratt for the C-64 Commodores. MFJ sells Multi-Com, which is available for the IBM-compatible PC, the Commodore 64, Amiga and the Macintosh. Kantronics sells Hostmaster II software for both the Macintosh and PC types of computers.

The first software I tested was the DOS version of PC-Pakratt-II. This software had been around for some time. It is an older type of software and doesn't appear to have undergone any major upgrades. There is no install program; you have to copy all the files from the floppy disk to the hard disk of your computer. You will also need to go in and initially do quite a bit of work to configure the software to run on your computer for your specific needs. There are no pre-existing files built in. You can set up macros or buffers to send information such as your station setup (a "brag tape"), QTH, personal data and other information that you might use regularly. Once you do have it set up it is a giant step ahead of using a dumb terminal. I found it a little harder to use than some third-party software.

The program allows many operations and comes with a built-in logging program. One of the major problems I came across was that the software operating manual was very skimpy. Software that requires a good deal of customizing should at least come with a detailed, easy-to-understand manual. The manual that comes with the 232MBX TNC is very detailed and very clear. I have always been able to get the necessary information from it easily and understand the different configuration options from the provided information in the manual, which is the way the software manual should have been done.

AEA now sells a PC Pakratt for Windows. The idea of Windows software is to provide the user with a graphical environment to allow complex computer operations to be performed easily without having to memorize a bunch of different key stroke combinations. The program has a true Windows setup program so that you install it in the same manner you install any other Windows program. The unfortunate part is that the setup only installs the TNC configuration files and doesn't create the basic macro files that make the digital modes easier and more fun to operate. The program uses a mouse interface so that you can point and click on operations such as calling CQ and sending your brag tape, or other saved files.

The software seems to have a fair amount of built-in capabilities, but as with their DOS version you will need to write all your own files and save them. This means that if you are going to use all of the digital modes the TNC is capable of, you will need to write a CQ file and sign-off file for each. There is really no reason they couldn't have the setup program prompt you to enter your call and other necessary information and have the CQ files and other basic functions created automatically. You can always go in and edit these files if you aren't happy with the files provided. I couldn't find how to do some of the basic functions that I use throughout QSOs, such as built-in keystrokes or mouse button pushes that send

the changeover from transmit to receive with your call and theirs. The main problem may not be the software, but the manual again. This was one of the least informative manuals I have ever come across. The information was presented clearly, but there wasn't enough for me to perform the necessary operations I wanted. For example, they briefly tell you how to create a macro to send CQ and give you an example using AMTOR. When I followed the same procedure for PACTOR it didn't work correctly.

The software also doesn't do automatic CQ and automatic entry of callsigns into the oversequence or log. One of the nice features about Windows is the ability to take the mouse and highlight text and easily copy it into temporary memory and pass that information into other applications. When I tried to copy the callsign of a station calling CQ to paste it into my connect request, I was rather surprised that it couldn't do it. I read the manual and it states that you can only do this from the scroll-back window. The scroll-back window is a very nice feature. You press a button and you can recall all the information from your QSO that has been appearing on the screen. You can then copy it and print it or paste it into another application.

MFJ sells MultiCom software to work with their 1278B controller. The software has the ability to work with the 10 digital modes that the controller is capable of. The design of the software can be set up to do macros in the same manner that PC-Pakratt-II can. I found the same flaws with the design of this software as I did with the AEA product. I found it a little hard to use and not as capable as the Lan-Link program. If you are going to use the FAX or color SSTV capabilities you might want to look at this product.

In addition to the manufacturer's specific

software, other people sell software that operates with different TNCs. Lan-Link is a shareware software package that can be set up to work with any of the three controllers I mentioned. This software was originally designed for packet. It is quite sophisticated in its packet handling abilities and has an impressive list of PACTOR functions. It includes the ability to do many automatic functions for contesting. The shareware approach for software allows you to get a copy of the product and try it out for a period of time. If you intend to continue using it, you send a registration fee to make the use of the software legal. The license fee for Lan-Link is a very reasonable \$45 and includes one free upgrade. I found that it was a fairly easy-to-use program. The program has a good install program. When you are done with the install, most of the automatic features are already functioning. You can program in an additional 10 other files that you can send with simple keystrokes. If I want to call CQ the software comes pre-configured to allow this in two different ways. I can press a button and the software will send the appropriate CQ for whichever mode I am in. With a different function key I can call automatic CQ. This will send CQ and then wait for a reply. If no reply is heard in a time period I specify, the software will repeat the CQ until someone responds, or I stop it. When someone connects, the software automatically takes their callsign and enters it for you to use in the changeover sequence or the logging program that comes with it. You will need to edit the brag tape to list your specific equipment. The brag tape is also sent with a single keystroke. This software has some sophisticated contesting options built in. I found that it could do everything I needed it to, and then some. To get more information contact Joe Kasser, G3ZCP at P.O. Box 3419, Silver Spring MD 20918.

Acuterm is a software program designed for use with the AEA 232 TNCs. I found this the easiest to use. I also like that there is a small log window on the screen and it keeps the information about the person's name and QTH on there until you tell it to log it permanently. The program has a very easy-to-use install program. When you are done answering the questions about your specific equipment you are nearly ready to run. This program also automatically sets up the CQ files and changeover macros. You need to customize your brag file and can easily enter five additional files that can be sent during a QSO. This software will also take the callsign off the screen and put it in the log area and use it for the changeover identification sequence. If you see someone calling CQ you can easily activate the log and enter the person's callsign. Once it is entered it will be used for the connect and be active during the QSO. The logging program also works well and is simple to use. This program was created mainly for the person who likes to rag-chew. It does everything I want it to do and I find that if I don't operate PACTOR for a while I can get right back on the air using this software without having to go through intensive software re-training. This is also a shareware product and you can use it 'til you log a set number of contacts. If you wish to get an official copy they are \$40 from W.R. Kissel N8BA, P.O. Box 395, Milford MI 48381.

Kantronics sells Hostmaster II Plus software which operates with their KAM TNC. I had heard good reports on the air about this software and was not disappointed when I tested it out. The software can be used with a mouse, which simplifies operations. After you go through the install program you will need to write all your macros for calling CQ and your brag tape. The difference is that with this software, once you have it set up, is simple to use

but performs many functions. To answer a call in PACTOR you just enter the person's call and press the connect function keys. The other person's call is then available in the changeover sequence and can be put into the included logging program automatically. To change from one mode to another you can just go to the top of the screen and select it with your mouse. The software allows you to have two windows on the screen to view both VHF and HF operation.

On the Air

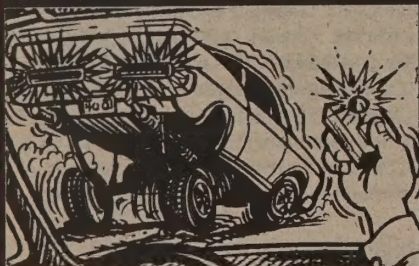
There are many different aspects to the digital modes. Contesting can take on a whole new appeal with RTTY or AMTOR. There are a number of RTTY contests throughout the year. The contests usually allow QSOs on RTTY, AMTOR or ASCII. I have found that most people work RTTY during the contests. I recently purchased software written by WF1B for RTTY contesting. This is one of the best software packages I have ever used. It is designed for use with a PC-compatible computer, and you can use a mouse to control most functions. I found that the software was so easy to use that I enjoyed getting into the contest strategy rather than worrying about the logging aspects of the contest. I am by no means a competitive contestor, but I managed to work 236 stations, many of which were DX. I only operated the contest when I was in the mood and did not stay up all night.

Whether you get into this part of the hobby with minimal equipment or go all out at first, I believe you will thoroughly enjoy the digital modes. Allow some time for each individual contact. You will find that when you make a contact you are much more likely to get into an actual conversation than on the other ham modes.

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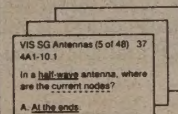
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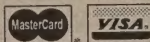
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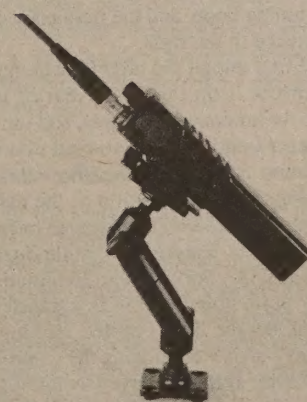
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RF review

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The ICOM IC-726

The HF + 6 road warrior.

by David Cassidy N1GPH

At the beginning of the summer of '89, television reception in the non-cable towns and villages of central New Hampshire turned strange. Every night, stations usually received with extreme clarity were fuzzy and filled with interference for most of the evening. For the rest of the world, this was another of the minor inconveniences of living with old-fashioned broadcast TV. For a ham, it could mean only one thing: 6 meter DX!

Signals were coming from places like Texas and Florida (I even saw the ID screen from a Dallas station). With this evidence of great 6 meter propagation staring me in the face (literally!), it was time to take a look at some of the available 6 meter equipment.

On The Road

Not too long ago, getting onto 6 meters meant buying or building separate equipment for that band. But not anymore. Now you can get the 6 meter band included with your HF rig. ICOM took their IC-725, added 6 meter capabilities, and re-christened it the IC-726. I've had the chance to put in several hours behind the mike of this rig, and this is what I found:

The layout of the operating controls on the IC-726 is pretty straightforward. The mode selection buttons are stacked to the left of the main tuning knob, and the frequency controls are stacked to the right.

The first thing I did after unpacking the rig was throw it on the front seat of my car, attach the antenna and power, and tune in the 20 meter band. Then I started driving the 40-minute commute home from work. After scanning the phone portion of the band with the tuning controls on the supplied microphone (a very handy feature for mobile operation), I called "CQ." For the next 20 minutes I had a very enjoyable QSO with a gentleman in Florida. By the time I pulled into my driveway, my hands were finding the controls without looking at the rig. Even switching bands was no problem; you just push the button marked BAND, use the mike controls to

select the band you want, then push the BAND button again. A quick glance at the frequency display, and that's all there is to it. A push of the LOC button disables the main tuning knob but leaves the UP/DOWN buttons on the microphone functional, so bumping the main tuning knob while reaching for the volume has no effect.

This was my first experience with mobile HF, and I was hooked. The IC-726 is now my constant copilot during my daily commute.

Back in the Shack

Once I arrived home, it took only a few seconds to set up the IC-726 at the operating desk. There is a plate on the back of the rig that tells what each jack, switch and plug is for, so the confident need not even look at the manual. In fact, this rig is so plainly laid out that anyone familiar with modern transceivers probably won't need to read what is, with few exceptions, a well-written instruction manual. (Once the initial excitement of any new piece of gear wears off, I would suggest spending 30 minutes or so with the manual, and if you are adding a linear amplifier or other gear to the chain, I would strongly urge that you take the time to go through the manual first.)

The spec rundown for the IC-726 is fairly standard for a modern HF rig: general coverage receiver, two VFOs, 26 memory channels (with two channels holding split frequencies), RIT, band and memory scanning, and variable tuning rates. One feature that I found very helpful was the built-in 10 dB preamp. Especially during mobile operation, that extra push in the signal-to-noise ratio can make the difference. The built-in noise blanker was also quite helpful in eliminating ignition noise. The backlit amber display is something else that I liked very much. All operating functions have an indicator, so you only need to look in one spot to remind yourself exactly where you are and what you're doing (another handy feature for mobile operation).

On The Air

I spent several weekends operating the IC-726 on every band, and in every available mode. Audio reports were consistently superb, even on AM where the newer rigs can't really compete with the audio quality of some vintage equipment.

Receiver audio is average, as long as you don't use the tiny speaker built into the cabinet. Almost any extension speaker will sound better. If you plan to go mobile with this rig, an extension speaker is a must. The built-in speaker started buzzing at relatively low audio output in the quiet of the shack. Mobile operation, even with the rig on the passenger seat and the speaker facing directly at me, was next to impossible.

This is really not a criticism of the transceiver. In order to put a larger speaker in the cabinet, the cabinet would have to be larger. Consider the built-in speaker as sort of a backup, and you'll have no problems or complaints.

As stated earlier, band changing is a snap. Tuning is very smooth and precise, even when tuning down to 10 Hz steps. The knob tension is easily controlled by a front panel screw, so those who like a looser or stiffer tuning can be accommodated.

What passes for tuning up in a modern transceiver is quick. Set your power level, check your SWR, and you're on the air. The IC-726 will give you 100 watts (40 watts in AM mode) on 160-10 meters and 40 watts (10 watts in AM mode) on 6 meters into an SWR of 1.3:1 or better. The automatic protection circuits kick in at higher SWR and your total output will be reduced accordingly.

QRP operation is a simple matter of turning down your RF power. Even when the power is turned fully counterclockwise, you'll still get about 10 watts output. This is due to the idling current supplied to the driver and final transistors to obtain bias voltage. If you want to operate serious QRP, a simple attenuator could be put in line.

What I Liked

1. Of course, 6 meter capability has to top this list. It's great to have that extra band. You don't get it for free, though. Only you can decide whether or not it's worth around \$300 to have the extra band. The way I look at it, you're already spending a lot of money so you might as well shell out a little more.

2. The front panel layout of this rig is excellent. Mobile operations are safe and easy.

3. The variable tuning steps are easily accessible. If you want to go from the FM portion of 10 meters to the Novice/Tech SSB subband, a simple button push lets you tune 1 kHz or even 1 MHz at a time.

3. The 10 dB preamp is great! I never realized I needed one until I had one. Now, I couldn't live without it.

4. The backlit amber display is well thought out and easy on the eyes. Everything you need to know is contained in about four inches of space, which adds another safety margin in mobile operation.

5. The band stacking registers will remember where you were the last time you were

tuned to a certain band. At first I thought, "big deal," but I found this feature very useful. Before tuning to another band, I always leave the VFO on a special frequency (the center of the phone portion, or maybe a net frequency). As I'm scanning the bands, that special frequency is waiting for me when I return.

6. The smooth and precise tuning is a real plus. Many rigs get a bit cranky when you're tuning 10 Hz steps. The IC-726 was easy to tune and never wavered.

What I Didn't Like

1. ICOM's biggest sins are sins of omission. It would be nice if the tone encoder and CW filter were standard instead of options, but to not include the carrying handle . . . shame, shame, shame. For a rig that is marketed as a base/mobile unit, the carrying handle should be standard equipment.

2. The manual falls short in helping you set up digital modes. In today's world of packet TNCs and multimode controllers, the transceiver manufacturers ought to get a bit more specific on how to set up their rigs for these modes.

3. The noise blanker circuit does not operate in the AM or FM modes. This made mobile AM work rather aggravating.

Options

ICOM has an extensive line of options for the IC-726. These range from the standard choice of power supplies, antenna tuners and external speakers, to a programmable tone encoder mobile mounting bracket, and the missing carrying handle.

The CR-64 high-stability crystal unit will improve frequency stability, especially if you will be operating in extreme weather (the CR-64 is rated from -22 degrees F to +140 degrees F). There are two different CW filters available. The FL-100 is a 500 Hz/-6 dB filter, and the FL-101 is good for 250Hz/-6 dB.

Other options include the CT-16 Satellite Interface Unit, which provides easy tuning for satellite communications, and the CT-17 Level Converter for remote control of the transceiver through your computer's RS-232 port.

Final Comments

ICOM's usual quality is evident in the IC-726. After two months of heavy use, including the daily switch from the shack to the car, the rig hasn't given any trouble. The simplicity of operation makes it a breeze to use, especially when going mobile.

If 6 meters is not your cup of tea, then you might want to save yourself a few hundred bucks and check out the IC-725. But if you're the type of ham who is always interested in putting your callsign out on another band or in another mode, the IC-726 is a great way to get on 6 meters with no hassles. The next summer DX season is right around the corner!

Reprinted from 73 *Amateur Radio Today*, December 1990.

[Editor's Note: The IC-726 is being discontinued. It will be replaced by the IC-729, \$1,521.]



The ICOM CT-16 Satellite Interface Unit

An easy way to change VFOs.

by Joe Holman KA7LDN

The ICOM CT-16 Satellite Interface Unit makes changing your uplink and downlink VFO frequencies as easy as changing a single VFO frequency. One of the most common complaints heard today among satellite operators is: "I am always playing catch-up with my uplink and downlink frequencies—I wish I could free my hands up more!" Well, you can now forget about this annoying and painful task.

The CT-16 is a small black interface unit that allows two of your ICOM x75 series rigs

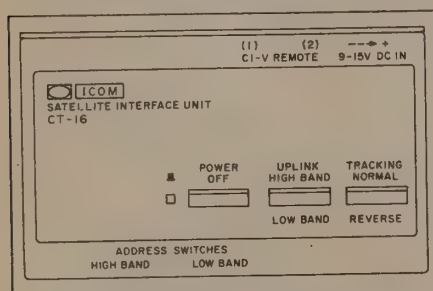


Figure 1. Ct-16 interface unit, top view.

to communicate with each other. When enabled, the CT-16 lets you simultaneously change two separate VFOs' frequencies (on the two different rigs) via one of the selected single tuning knobs on your rig. The CT-16 interface unit works well with any ICOM rig using the ICOM CI-V communication system. (All ICOM x75 series rigs use this type of communication system, except for the IC-735.)

How It Works

The CT-16 Satellite Interface Unit bidirectionally sends (serially) two ICOM x75 rigs packets of information via the interface unit. The ICOM CI-V (Communication Interface - V) System uses the CSMA/CD (Carrier Sense Multiple Access with Collision Detection) standard.

A packet of information contains two main types of data, plus some other codes. The first main type of data is a unique number or "address" pertaining to a particular ICOM rig, such as 16 for the IC-275 and 20 for the IC-475. The second main type of data contained in the information packet is a command which tells a particular rig what task to perform. The standard format of an information packet is as follows:

preamble preamble RX address TX address command frequency end of message code

Each section is one byte in length. The "preamble" tells the microprocessors that a command is arriving. The "RX address" is the

rig/CT-16 address which is sending the packet of information. This is needed so that an acknowledgment can be detected with the same address in the TX address byte. The "TX address" denotes which rig is supposed to receive and process the command. Since both rigs receive all commands, commands received by the "wrong" rig can be ignored. The "command" is which command is to be executed. The "frequency" is the frequency to be set, or returned from an interrogating command. The "end of message code" tells the microprocessor that the complete packet of information has been completely sent.

The following types of CI-V commands are available:

- set frequency
- mode set
- band edge read
- frequency read
- mode read
- frequency set
- VFO set
- memory channel set
- memory channel read
- memory channel write to VFO
- memory channel clear
- scan start or stop
- split operation

All information packets can be sent at either 300, 1200 (default), or 9600 baud.

Remember, a particular rig can only pro-

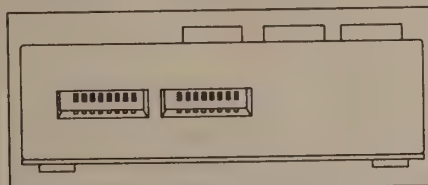


Figure 2. Address switch locations, front view.

cess a frequency command when its internally stored address matches the address received in an information packet. All other packets are quickly discarded by the rig's microcomputer. All addresses are factory-prearranged/assigned, and will never be the same for two different rigs.

Pre-Operation

Before depressing the power switch, which enables the interface unit, you need to set the address switches properly according to which rigs are to be controlled, select the uplink switch position, and select the tracking. (See Figure 1 for a top view of the interface unit, and Figure 2 for a front view of the interface unit's address switches.) Remember: Once depressed, the power switch enables the unit

so you must make all pre-adjustments prior to switching the power on.

The address switches tell the interface unit what rigs are connected. If you select the wrong address of the right rig, the rig will not respond to any command that is sent to it. Unfortunately, the interface unit cannot notify you of this mistake, and all your efforts will soon fail when the power is turned on.

When trying out the interface unit, I connected the IC-275A and IC-475A rigs to it, setting the address switches as shown in Figure 3. The uplink switch selects which rig will be the "master" rig (usually the uplink), and which is the "slave" rig. When the interface is enabled, the master can change the slave's frequency hertz for hertz as you turn the VFO frequency dial on the master. For example, if you change the master's frequen-

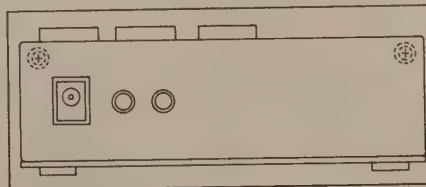


Figure 3. CT-16 (rear view).

cy by 5 kHz, the slave's frequency will also change by 5 kHz. Note, however, that when the uplink switch is in the high band position, the interface unit assigns the rig which operates in the higher frequency range to be the master controller. When the switch is in the low band position, the interface unit assigns the lower operable frequency rig to be the master.

But, was that previous change in frequency +5 kHz or -5 kHz? To answer that question you must examine the tracking switch. If the tracking switch is in the normal position, the interface unit coordinates the slave to change its frequencies in the same direction as the master does (up 5 kHz on the master, up 5 kHz on the slave, and vice versa). However, if the tracking switch is in the reverse position, the interface unit changes the slave's frequency in the opposite direction than that of the master (up 5 kHz on the master, down 5 kHz on the slave).

The tracking switch is a very important switch on the interface unit. You will want to have it in the reverse position if the transponder you are working inverts its signals, such as for all OSCAR 13's transponders. However, if you are working a satellite which does not invert its transponder signals, such as RS-10 in Mode A, you will want the tracking switch in the normal position-noninverting. Figure 4 presents some example tracking switch settings for some common satellite modes.

Tuning In (Standard Operation)

Just before switching the CT-16's power on, adjust your uplink and downlink frequencies—because, once you turn the power on, you are off and running! For proper operation, you will need to set your uplink and downlink frequencies at the upper and/or lower satellite range limits, depending upon the satellite's transponder.

If the transponder inverts signals, set the downlink frequency to the transponder's lower edge, and the uplink frequency to the transponder's upper edge. For example, on OSCAR 13 Mode B, I set the IC-275 to 145.825 MHz and the IC-475 to 435.570 MHz. Then I can switch the interface unit's power on and adjust frequencies by means of the master rig. As I turn the master rig's tuning knob counterclockwise, the IC-475's frequency decreases,

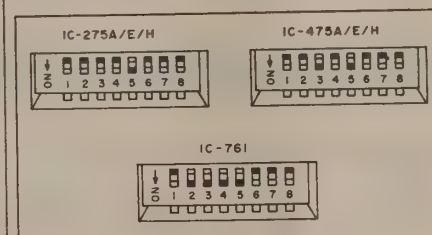


Figure 4. Transceiver address settings.

and the IC-275's frequency increases! Pretty easy, and one of my hands is free!

However, if the satellite's transponder does not invert signals, set both your downlink and uplink frequencies to the transponder's lower band edge limit. On RS-10 Mode A, this means setting one rig to 145.860 and the other to 29.360. Then, switch the interface unit's power on. Now, when enabled, as you increase the master's frequency by turning the master's VFO knob clockwise the slave's frequency increases, and vice versa for the other direction.

Blink Blink Blink

One of the features of the CT-16 I especially like involves the power indicator. Normally, the power indicator shines brightly whenever the interface unit is supplied approximately 12 volts DC. However, if you ever tune to a particular downlink frequency that correlates to an out-of-band edge uplink frequency, the power indicator blinks on and off repeatedly until you move back to an in-band frequency.

This is a real handy feature in case you do not have a frequency chart right in your hand after tuning up for the initial time. If you set the satellite's band limits before turning the power on, you will not have to look up at the chart again to find a particular set of band limits because each time you go out of band the power indicator flashes, telling you that the current frequency is out of range.

Power Requirements

The CT-16 interface unit does not require much power but it must be connected to a

Continued on page 12

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The ICOM CT-16

Continued from page 11

power source which provides some clean power between 9 and 15 volts DC. Since the majority of the unit's components are digital it does not draw much current—the interface unit only requires approximately 25 mA. Just about any standard power supply provides these ratings. The interface unit comes with a nice DC IN jack that plugs directly into the back panel of the unit.

The Final Word

The CT-16 is a great little unit and I would recommend it to anybody owning compatible ICOM equipment. After setting up the CT-16 you can pay less attention to the annoying task of continually tweaking the frequencies of your satellite uplink and downlink rigs. You can have more fun—and that's what we are all here for, isn't it?

I only found one thing that I did not like

about the CT-16: the number of communication ports available. Currently, the interface unit only supports two rigs to communicate to each other simultaneously. I think it would be a great idea to have more than two ports available and to have switches to interact with different sets of rigs.

And, ah yes, the infamous Doppler shift. The interface unit cannot automatically make up the difference for the satellite's Doppler-shift-affected signal. This means that you have to retune your master rig's frequency to compensate for Doppler shift.

Here's a note for amateurs using the previous ICOM CI-IV communication system (IC-751, IC-751A, IC-R71A/E/D, IC-271A/E/H, IC-471A/E/H, and IC-1271A/E). The CI-IV communication system can use the CT-16 by using an ICOM-designed converter, the UX-14. ICOM offers the UX-14 CI-IV/CI-V converter for about \$86 (suggested retail price).

Reprinted from 73 Amateur Radio, July 1990. **RF**

Satellite Station		Uplink Frequency	Downlink Frequency	Uplink Switch	Tracking Switch
	B Mode	435 MHz	145 MHz	Out	In
AO-13	J Model	145 MHz	435 MHz	In	In
	L Mode	1296 MHz	435 MHz	Out	In
RS-10	A Mode	145 MHz	29 MHz	Out	Out

Figure 5. Satellite frequency chart/tracking switch.

Custom Meters

by Frank Kamp K5DKZ

If you build your own equipment, sooner or later you will come across a project requiring a meter. You can purchase the exact meter listed in that project's parts list, or you can try to adapt a surplus meter, as long as its movement has greater or equal sensitivity.

Regardless of what is indicated on the face of a surplus meter, almost all of them are current devices, and the majority have 1 mA movements. If you didn't have to pay more than a few dollars for it, chances are good that your surplus meter falls into this category. If it has a scale reading more than 1 mA, it could still be a 1 mA meter movement with an internal shunt. Some meters even tell you what the movement is, right on the face plate in fine print, next to the manufacturer's logo.

Let's say you got a super deal on a meter. Its scale is calibrated in "Light Output." Other

than that cryptic legend, there is absolutely no other information. Let's see how you can utilize this typical surplus treasure.

You could spend a lot of time rigging up a test setup that will measure the internal resistance of the meter movement. If you want to go through the calculations for shunt resistance, you need that value for the formulas. There is also a simpler way to do this which requires only a stable voltage source, an assortment of precision resistors, and $E = IR$. If you have an accurate ohmmeter, you don't even need the precision resistors. I use a regulated 12 VDC, 1 amp supply for my measurements, but almost anything, including a 1.5 volt battery, could be used. If you use a battery you will want to accurately determine its voltage under load.

Assuming the use of a regulated 12 VDC supply and a suspected 1 mA meter, we can

proceed as follows: Verify the meter movement by connecting it to the supply in series with a 50k ohm resistor. Just touch the connections momentarily. If the meter needle just barely moves, reduce the series resistance by increments of 5k ohms until you get a full-scale reading without pegging the needle into the stops. A 1 mA movement will take a 12k ohm series resistor for a full-scale indication using a 12 VDC supply. The precautions in approaching full-scale slowly prevent pegging the meter into the stops and damaging it.

Let's say your meter does have a 1 mA movement, but you need a 100 mA meter. I use a simple "cut, try, then calculate" method. Get a length of #30 wire wrap wire. A couple of feet should be enough. Strip the ends and solder the wire across the meter terminals. Hook up this newly shunted meter to

the 12 VDC regulated supply by connecting a 12k ohm resistor in series with it. Note the meter reading. A third-scale deflection will indicate that you now have a 3 mA meter. A 10th-scale deflection makes it a 10 mA meter, and so on. Say you did get a 10th of total scale deflection indicating a 10 mA meter, but you wanted a 100 mA meter. Unsolder the temporary wire wrap shunt, reduce its length by a factor of 10, and reinstall it. You should now get full-scale deflection using the 12 VDC supply in series with

a 120 ohm resistor. Now you have a 100 mA meter. Record the results you get and you will have a ready reference for making other shunts for this meter. For instance, one-third the length of the 100 mA shunt will get you a 300 mA shunt for that particular meter. Or, you can go the other way: Twice the length will get you a 50 mA meter. Nothing complicated, just a simple use of ratios.

After you have determined how much wire to use in the shunt, you can wind it onto a resistor body and solder the shunt leads to the resistor wire leads. Almost any resistor value will do here because the shunt is normally only a few fractions of an ohm in resistance. I don't spend a lot of time getting the shunt exactly right, either. I would be happy with a 120 mA, ballpark, full-scale deflection of a newly-shunted 100 mA meter because the scale will be re-drawn and re-calibrated anyway.

Any CAD drawing program can be used to make a new meter face. Even some of the lesser-capable drawing programs will do a fair job. I use an old version of AutoCad and printer-plot the output to an old HP LaserJet printer. Once you have a new meter face designed, mount it on the meter and calibrate it with the new shunt installed. In the case of the 100 mA meter with 12 VDC supply, you will need at least one 240 ohm and one 120 ohm resistor. These will deflect the meter to 50 mA and 100 mA, respectively. Mark the location of the meter needle directly on the new meter face with a pen for both half-scale and full-scale readings. Now go back to the drawing program, scale your experimental meter test results, and duplicate them in the drawing. You can now subdivide the half- and full-scale marks in the drawing, print a new face and install it in the meter.

If you choose not to make a new meter face, you can still get an accurately calibrated meter by adjusting the shunt length to a greater degree of precision. Then make use of the existing meter scale. **RF**

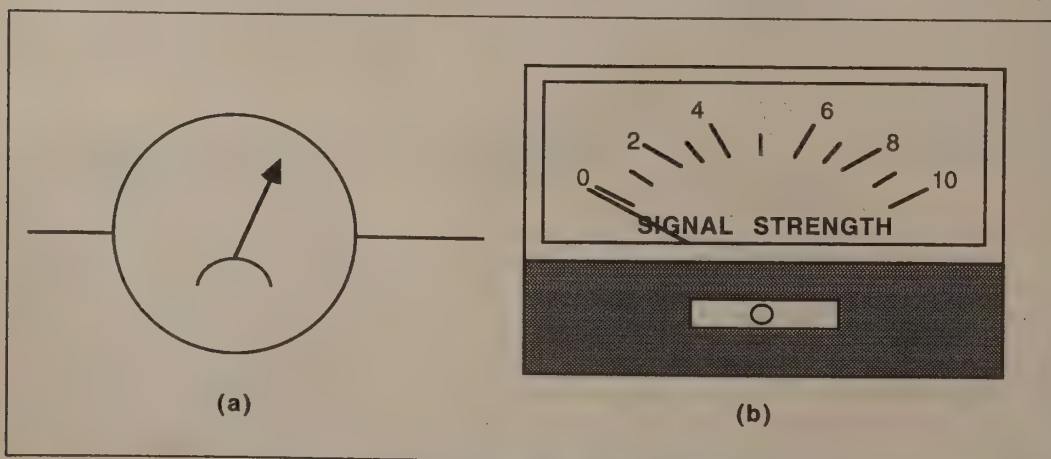


Figure 1. (a) Meter symbol, (b) typical meter face.

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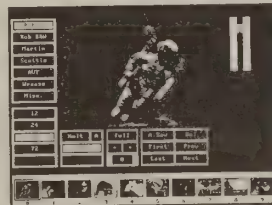
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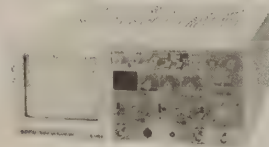
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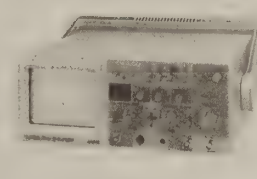
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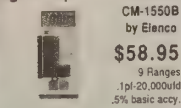
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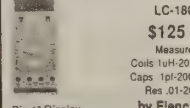
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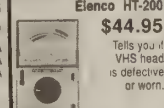
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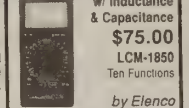
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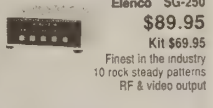
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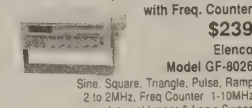
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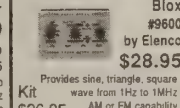
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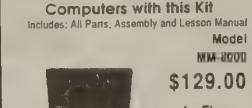
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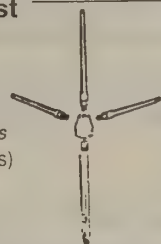
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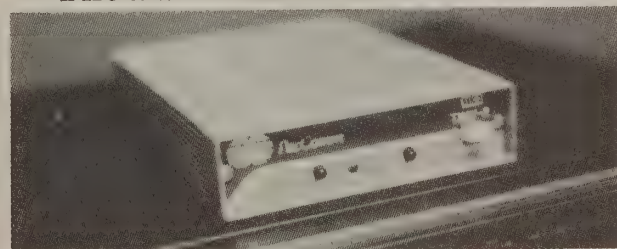
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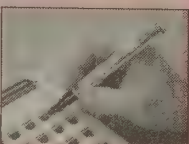
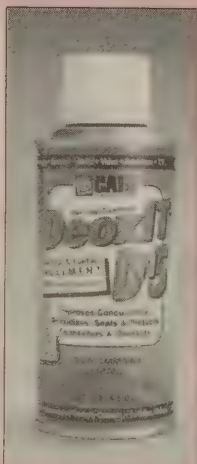
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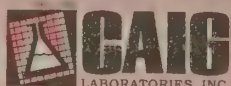
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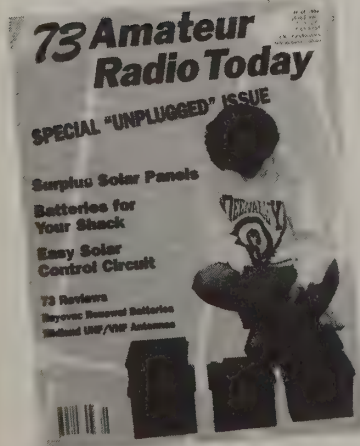
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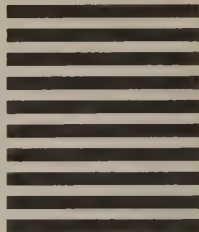
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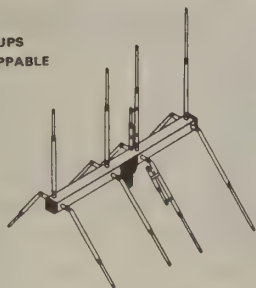


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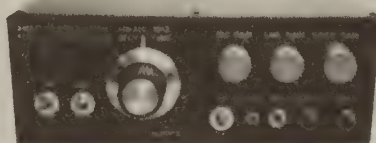
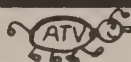
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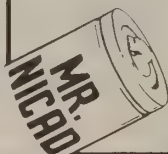
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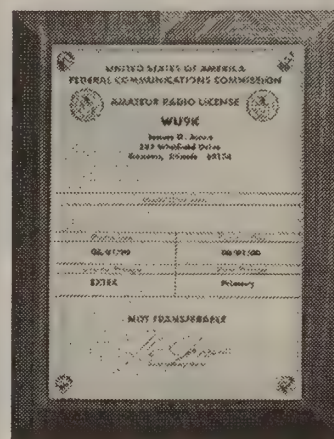
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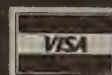
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DISCOVER

This Month in 73 Amateur Radio Today

If you don't read the October issue of *73 Amateur Radio Today*, here's what you'll be missing:

- October is QRP month, and this month's *73* is packed with low-power fun!

- In the "Battle of the Monobanders," Mike Bryce WB8VGE slugs it out in the QRP arena. Mike lends his unique perspective to the ham interested in purchasing a single-band QRP transceiver, with comparisons of all the many rigs he's tried.

- "The Traveler" is a sweet home-brew

to build your own.

- Build your own "Handy Randy"; (with apologies to American Express); you won't want to leave home without it! This tiny tag-along *almost* random wire tuner for QRP is a cinch to make, and imagine the fun you'll have operating at remote locations with Handy Randy and an easy long-wire antenna.

- Fire up the soldering iron and build your own "Quickie Cheapie Toner"—perhaps the easiest way to get a 1 watt CW rig for the 10 meter band. Fabio Veronese says

receiver for 80 meters that you can cook up this fall on a single PC board. This simple, high-performance SSB receiver is designed around the Motorola MC3335P IC chip. Let Paul Daulton K5WMS show you how

"arrivederci" to full-power operation and shows you how to build this slick flea-power code rig with just a handful of components. We take you all the way to Briosco, Italy, for this great project!

- Antennas are the mothers' milk of ham radio, and *73* always takes care of you with plenty of antenna projects! This month, build a "Capacity Tuned Folded Loop," a 1/3 wave 20 meter wire antenna. Jim McLelland WA6QBU puts it all together for the kind of money you'll likely find trapped inside your living-room sofa. That's not much to pay for a real performer.

- Want to quick-charge your HT without shelling out for a new charger? Michael Geier KB1UM shows you how to convert a common video charger to do the job.

- You say you want reviews? *73* always comes through, and October is no exception.

- Read all about QRP rigs from A&A

Engineering, MFJ, and Techsonic in this month's *73*!

- You expect to find the best reviews in *73* and we won't let you down.

- In October's "Homing In," Joe Moell KØOV brings you the story on navigation and networking via packet.

- Bill Brown WB8ELK tells about the record-setting DX achieved through the California-Hawaii duct in this month's "ATV."

- Chuck Houghton WB6IGP takes you "Above & Beyond" in October with his look at VHF/UHF/microwave frequency counters.

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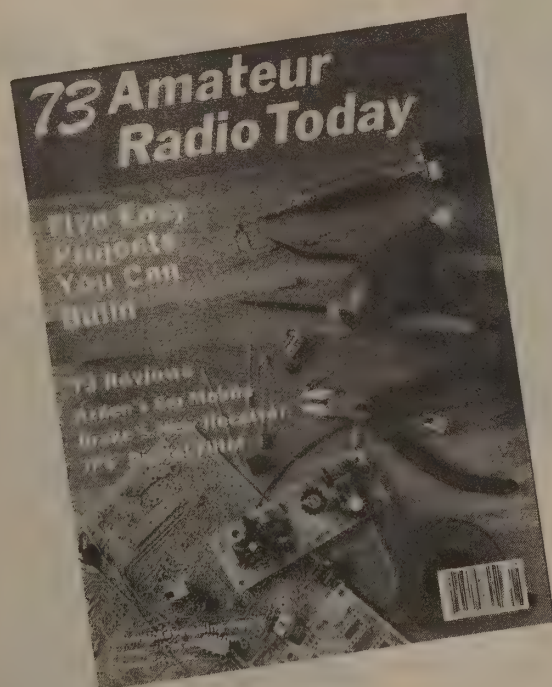
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Tenacious Ten

by Edward Oros AC3L

Have you already given up on the 10 meter band? Although it's true that you can, at times, scan the entire phone band and not hear a single station, the band is far from dead. Even with the declining sun spot activity and the pesky solar flares that keep messing up the band, 10 meters keeps on coming back. The secret is knowing when to listen and what to listen for. This article will help you find the activity that is surely out there!

Determining If the Band Is Open

There are three easy ways to identify if the band *should* be open:

First, tune into WWV. This radio station broadcasts on 2.5, 5, 10, 15, and 20 MHz. Start by checking 20 MHz and see if WWV is giving you a good strong signal. If it is, 10 meters may indeed be open; if you can't hear it, it's likely 10 will be dead. Also, be sure to listen for the solar "Numbers" on WWV at 18 minutes past each hour or 45 minutes past for WWVH in Hawaii (WWVH is not on 20 MHz). If the solar flux is reported above 90 and the A index is under 10, start calling CQ DX on 10 meters! The higher the flux and the lower the A index, the more DX you'll be working.

Next, there are the numerous beacon stations operating at the high end of the 10 meter CW band, just below 28.3 MHz. The beacon stations can be identified by the suffix added to the call, "/B" and "/BCN" are commonly used. It's amazing how many times these low-power stations are solid copy into my station when there isn't a soul to be found on the band! Don't give up, though, if you can't find any beacons—the opposite

can also be true. You might not hear a single beacon on the air, yet there may be an opening to an area where there is no beacon.

Here is a list of just a few of the beacons to listen for when the band seems to be dead:

- 28.225 KW7Y/b CAMANO ISLAND, WA 4 watts
- 28.244 WA6APQ/bcn LONG BEACH, CA
- 28.280 NO6J Thousand Oaks, CA
- 28.259 KAINSV/bcn Cape Cod

Lastly, the band itself can tell you if an opening is in progress. Often when the band is opening or closing, blips, beeps and pops can be heard flashing across the band. It has a sort of machine-gun sound to it. Once the opening is in full swing, the noises will cease.

What Type of Propagation Should You Listen For?

Aurora: If you live in one of the Northern states, you can cash in on this one. When ever WWV reports a K value above 3, turn your beam north for lots of fun. Don't worry if the voices sound like they're under water, this is normal.

Satellites: Start asking around about 10 meter satellite activity. If you can't find anyone with information, just start camping out on 29.408 MHz. Sooner or later you'll hear the RS-12 satellite CW beacon. Then tune 29.410 through 29.450.

The band goes crazy every day!

Meteorite Scatter: Again, ask local hams if they've ever played around with this mode. If nothing turns up, check the local papers for reports on the various annual meteorite showers and the dates. Listen during the peak of the shower. Signals will appear, peak, and then drop off quickly.

Sporadic E: This type of propagation can occur at any time so you really just have to be there at the right time if you are going to catch it. The peak months seem to be mid-summer and mid-winter. Northern states should point their beams southwest or west. The propagation often oscillates back and forth between the two directions. Southern states point north or northeast.

Ground Wave: After dark, and especially on evenings when even the Sporadic E is not running, check out the band for ground-wave signals. The best time for contacts is between

8 and 10 p.m. local time. Local groups congregate across the band each evening and many clubs have weekly meetings on some preset frequency. Sunday evening seems to be a popular meeting night. The best frequency I have found to

"After dark, and especially on evenings when even the Sporadic E is not running, check out the band for ground-wave signals."

date is 28.400. It seems that if there is any activity out there at all, tuning to 400 will find it. Also, don't forget 29.0 for AM activity and 29.6 for FM simplex. If you have a good location or a decent gain antenna,

contacts a hundred miles away can be made regularly. (This would actually be line-of-sight communications, since "TRUE" ground wave on 10 meters would only exist to about 15 miles or so.) To encourage ground-wave activity, one local ham club in my area sponsors a yearly Ground-Wave Contest. Notification is sent out to the various clubs and hams in the neighboring cities and states. Consider this at your next club meeting.

Propagation Begins at Home

If all of these modes have been tried and you are still not finding any activity, the problem could be with your antenna. If at all possible put up an antenna with gain. In case you haven't already heard this: "You can't work 'em if you can't hear 'em!" It doesn't have to be six elements on a 36-foot boom either! A 14-foot boom with three elements can give you around 7 dB gain over a dipole. You will be amazed at how much better you will be hearing stations. What you had always thought was a dead band will actually be hopping with activity.

OK, let's say you just don't have the room to put up a beam of any sort. Try a 5/8-wave vertical. You still get 3 dB gain over a 1/4 ground plane. Gain is gain, however you get it!

Even half-wave dipoles and half-wave verticals mounted close to the ground (15-25 feet above ground) can be the perfect antennas . . . if the conditions are right. Sporadic E on 10 meters provides these conditions. These antennas have a high angle of radiation and let me tell you, I've worked hundreds of stations when the Sporadic E comes in and some of the strongest stations are those running these types of antennas.

Now that you know some of the many secrets of the 10 meter band, you'd better buy an extra log book or two, because you're going to need it to track all the additional contacts you're going to make soon. See you on 10!

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Propagation Primer

Understanding how radio signals travel through atmosphere and space.

by Robert C. Green W3RZD

After making a DX contact, have you ever wondered how the signal arrived at the other station? Or did you ever speculate on whether low frequency and high frequency waves behave differently after leaving an antenna?

If you have asked these questions, join the crowd. The answer lies in the word "propagation," and knowing something about propagation may answer some of your questions about antennas. Understanding antennas and their construction is not the same as understanding propagation; they are different subjects, but closely related.

Propagation conditions vary worldwide with the time of day. In any discussion or text, when terms like daylight, noon, evening, darkness, etc., are used, remember that these apply only to local time. Propagation conditions in an area where it is daylight will be different from those where it is nighttime. As an example, when it is midnight in England it is still daytime in California.

Radio waves are electromagnetic waves that are similar to other types of electromagnetic waves, such as infrared or light. All of these waves are forms of radiating energy that have their own distinctive frequency, and are everywhere around us. Figure 1 shows the vast frequency spectrum from sound waves to cosmic rays.

Covering the earth are the atmosphere and the ionosphere. The atmosphere is the air we breathe, and it extends to a height of about 100 miles. The ionosphere is an area of ions (hence the name) that begins to mix with the atmosphere at a height of about 30 miles, and extends to about 250 miles, which is considered the beginning of space. (Texts vary on the distance, some putting it as high as 400 miles.) The ionosphere is created by the sun, which is constantly charging the atoms in that area and breaking them into negative and positive ions. This process is commonly known as *ionization*. There are four layers of ionization, and during daylight hours the ion density of each layer is more pronounced than at night. Also, each layer will have some effect on radio waves; we will see later how this happens.

Years ago the ionosphere was referred to as the Kennelly-Heaviside layer, named for two scientists who suggested that such an area existed. We now know for certain that there is an ionosphere and have given it its own terminology. The term Kennelly-Heaviside layer is now thought of as outdated.

Radio Waves

How a radio wave travels after leaving a transmitting antenna can be visualized quite easily while you are having breakfast. You may

have eggs and coffee but the menu must include doughnuts (the plain kind, please, no jelly or cream-filled). Place one of the doughnuts flat on the table and stick a pencil vertically in the hole, and assume the pencil is a transmitting antenna. When our make-believe transmitter is keyed, radio waves will leave the pencil antenna in a manner that resembles the shape of the doughnut. As the doughnut-shaped waves travel outward they will get bigger and bigger, but at the same time the energy in the waves will get weaker and weaker. Some of the waves will spread out across the tabletop, which we will call the surface of the earth, and some of the waves will travel towards the ceiling. If we consider the ceiling as the beginning of space, the area between it and the tabletop will be the ionosphere and atmosphere.

See Figure 2. The outward edge of the doughnut-shaped signal is called a *wave front*, and is made up of lines of force that resemble a window screen, with the screen encircling the antenna. A window screen is made up of two sets of wires, vertical and horizontal, so think of each set of wires as separate lines of force. Because the antenna is vertical it is said to be vertically polarized, so in the screen the vertical wires are *electrostatic* lines of force, and the horizontal wires are *electromagnetic* lines of force. Thus, the lines of force forming the wave front are at right angles to each other, and the plane, or face, of the wave front is also at a right angle to the surface of the antenna. The electrostatic lines are the voltage part of the wave front and the electromagnetic lines are the current part of the wave front.

So far, only one wave front has been mentioned, but actually there are a series of wave fronts. Each wave front is spaced from the one ahead of it and the one behind it by the frequency of the transmitted wave. Meaning, if the transmitter is operating on 15 meters the wave fronts will be spaced by 15 meters or 49.2 feet. One meter is 3.28 feet, so 15×3.28 equals 49.2 feet.

If the doughnut and the pencil had been held so that the pencil was horizontal, the antenna would have been horizontally polarized and the wave front would have been rotated by 90 degrees. The electrostatic field is always parallel to the direction of the antenna.

The words *reflected* and *refracted* are used extensively in any discussion of propagation. A reflection occurs when a radio wave strikes one of the ionized layers at an angle and bounces off at a similar angle. A refraction occurs when a wave strikes an ionized layer and is not reflected but penetrates the layer.

Upon entering the layer, the penetrating wave will be bent to a new angle, and this bending is called refraction. The wave may or may not bend again and leave the layer to return to earth. If it does return to earth it will probably be at a different angle than which it struck the layer. See Figure 3.

A transmitting antenna located near the ground will emit both a *ground wave* and a *skywave*. The ground wave is the energy that travels on or near the surface of the earth and also through the ground, and will eventually be absorbed by the earth. The skywave is the energy that leaves the antenna at an upward angle and travels towards the ionosphere. See Figure 4.

Frequency Categories

In the vicinity of 3 MHz there is an indistinct dividing line in propagation characteristics. Signals below the line are considered to be a low frequency and will behave differently than signals above 3 MHz. Let's start with the low frequencies and work up.

During daylight hours the ground wave is the main source of energy at a receiving antenna, and any other waves will have very

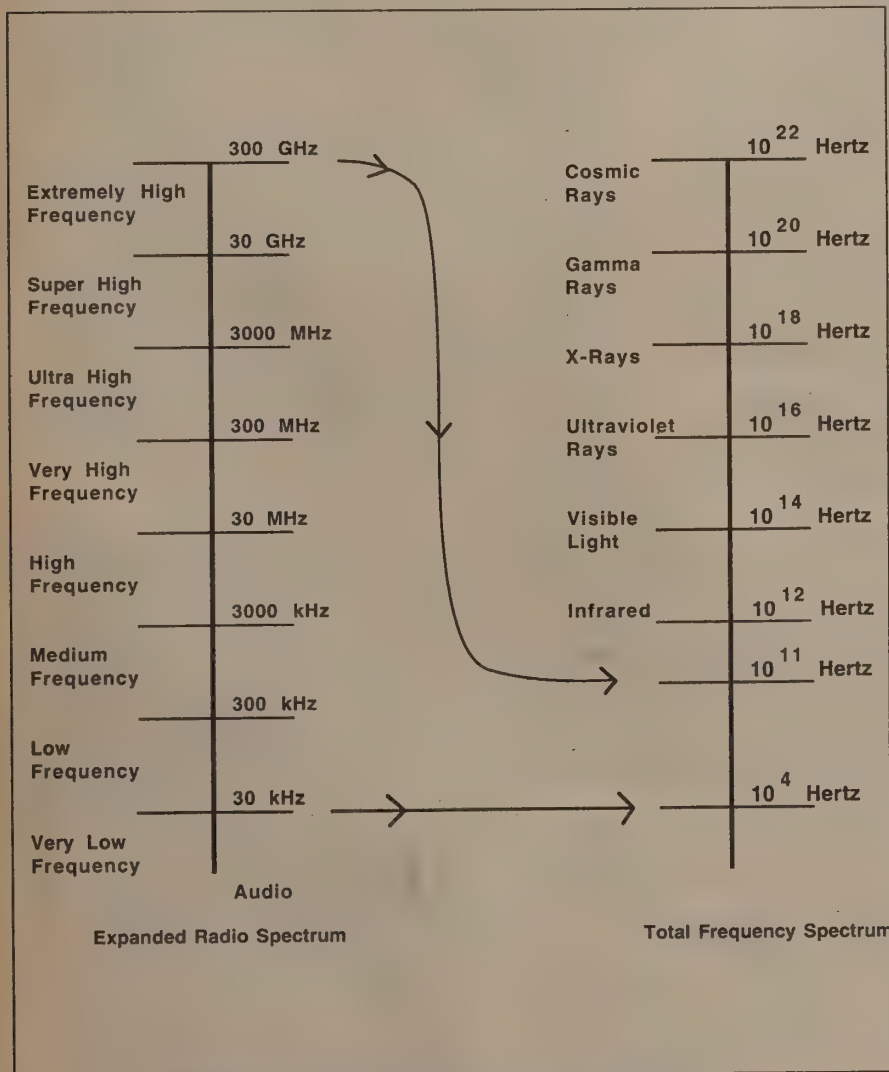


Figure 1. Electromagnetic frequency spectrum.

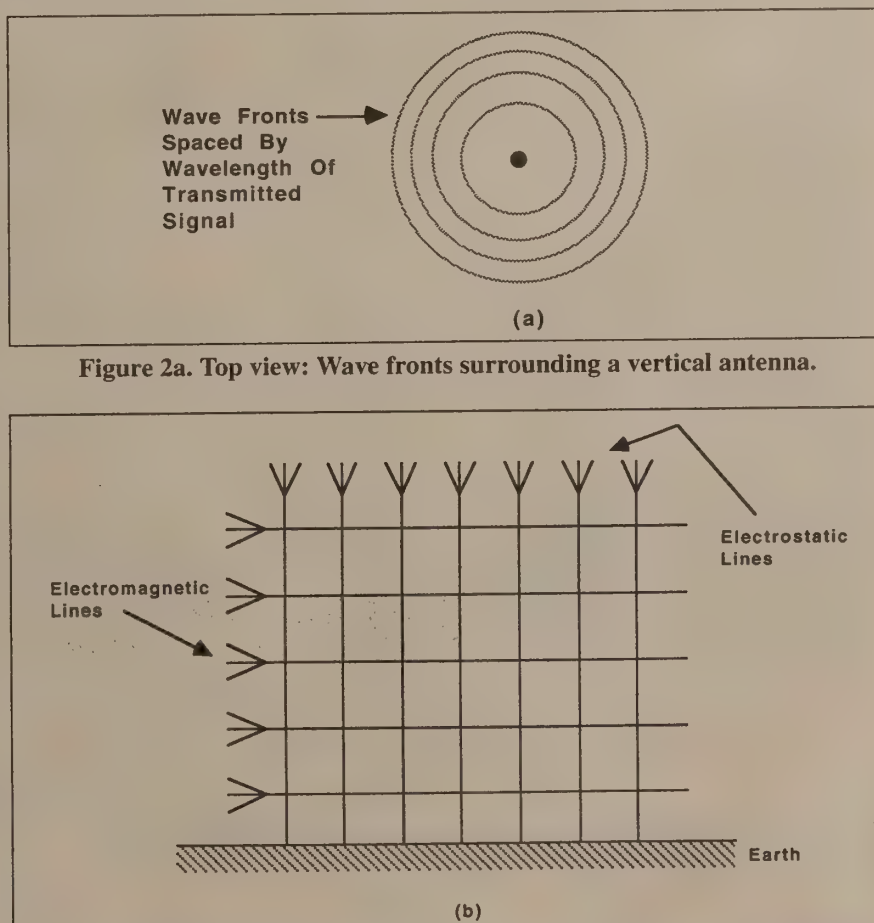


Figure 2b. Front view: Wave front for vertical antenna.

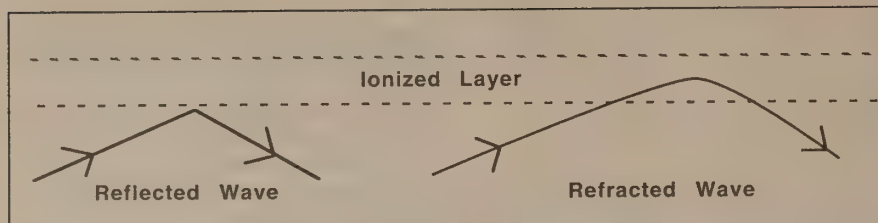


Figure 3. Reflection and refraction.

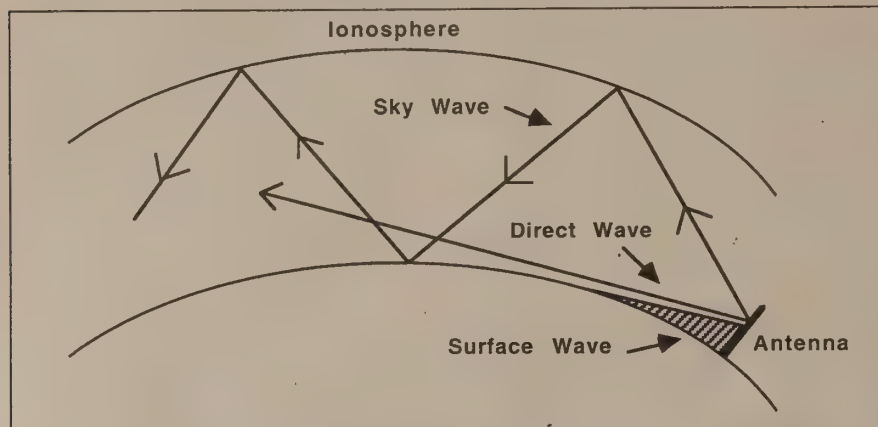


Figure 4. Ground waves and skywaves.

little effect. Not many low-frequency skywaves are reflected as most are absorbed by the ionosphere. Those that are reflected will be at a sharp angle and will strike the earth close to the transmitting antenna. At night there is less absorption and reflected waves will return at a greater angle and strike the earth farther from the transmitting antenna.

When a reflected skywave strikes the earth, some of its remaining energy will be absorbed by the earth, and the rest of the wave will be reflected back to the ionosphere. Again, part of the wave will be absorbed by the ionosphere and the remainder will be reflected back to earth. This can continue until all the energy in the skywave is absorbed by the earth and ionosphere.

The distance between points where the skywave strikes the earth is known as *skip distance*. The distance from where the ground wave ends and where the first reflected skywave strikes the earth is the *skip zone*. If the reflected wave does strike the ground several times, each time further from the transmitter, it is called multihop skip. See Figure 5.

The part of the ground wave that travels along the earth's surface is called the *surface wave*. Some of this wave will be absorbed by the earth; the amount of absorption is determined by the conductivity of the earth. Since the earth is a rather poor conductor it has high absorption; however, when the wave travels over saltwater the absorption is 4,000 to 5,000 times less.

The part of the ground wave that is not absorbed by the earth will be reflected at a small upward angle and will travel just above the earth's surface. The wave that now reaches the receiving antenna is made up of the surface or ground wave and the reflected ground wave, plus a small amount of *direct wave*. The direct wave is that portion of the transmitted wave that is not a part of any other wave, and it also travels just above the earth's surface. The

combination of the ground wave, reflected ground wave, and the direct wave is the *space wave*. This space wave should not be confused with any waves that may reach the area above the ionosphere. Usually transmissions between line-of-sight points are made by the space wave. The space wave can arrive at the receiving antenna in the form of a weak signal, due to the time difference between the reflected ground wave and the ground wave.

The amount of absorption by the earth does not vary, so the distance the ground wave will travel can be calculated if the transmitted power is known. As an example: AM broadcast stations rely on the ground wave for their primary coverage, so the absorption "factor" is figured in to determine what area will be covered, and that result is used when applying for a license. The skywave coverage of an AM station is unpredictable, during both daylight and darkness, so it is never considered in determining the primary service area.

Before we finish our look at low frequency waves, there is one more term that should be defined, and that is *diffraction*.

Diffraction, or a diffracted wave, can be developed if there is not a "line-of-sight" between the transmitter and receiving antennas. The lack of a line-of-sight is usually due to an obstacle, natural or man-made, and the receiving antenna is located behind the obstacle. If the

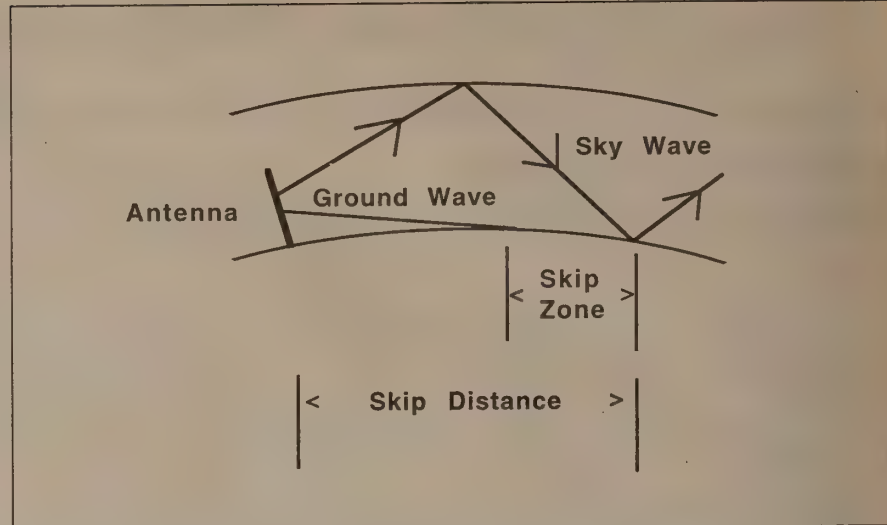


Figure 5. Skip.

receiving antenna is in a valley, the walls of the valley are considered an obstacle. With the receiving antenna in the shadow of the obstacle, only waves that are diffracted or bent downward over the top of the obstacle will be received. There can also be diffraction due to the curvature of the earth. Diffraction can produce a weak signal, but rarely will the signal be shielded completely. See Figure 6.

We have seen that the ground wave is used for communicating on low frequencies, but why can't the ground wave be used when the frequency is raised above 3 kHz? The answer is ground absorption. The amount of ground absorption increases very rapidly with frequency and the ground wave becomes of such little value that we have to rely on the skywave. This becomes a whole new ball game, and one that is played in the ionosphere.

We know that the ionosphere is a mass of ions, both negative and positive. We also know the sun is constantly spewing out particles of radiation of all types, including ultraviolet, that bombard the atoms and change them into ions. During the bombardment the negative ions become charged to a very high level of energy and form ionized layers.

The density of the ion charge in

each layer does not remain constant because it is affected by forces such as the magnetic field of the earth, the changing intensity of the radiation from the sun, and the amount of air present. The energy level will also vary with the time of day and the season of the year.

There are four layers of ionization and each layer has a different density. Only the three layers with the highest density can cause the reflection or refraction of a radio wave. We already know that if a wave is reflected it will

be at the same angle at which it struck the layer. We also know that a refraction occurs when the wave penetrates the layer and is bent to a different angle, and may or may not return to earth. If the wave does not return to earth it will penetrate even farther into the layer. When the wave penetrates deeper, either of two things can happen: It can be absorbed entirely or pass through and strike a higher layer. If the wave does pass through it can be reflected or refracted again by the new layer. Even after passing through three lower layers it is still possible for the wave to be reflected or refracted back to earth by the highest layer.

The layers are named D, E, F1 and F2, with D closest to the earth. Their positions are shown in Figure 7.

The D Layer

The D layer begins about 30 miles above earth, is about 10 miles thick, and has the lowest amount of ionization due to its distance from the sun. It is very evident during daylight hours, beginning about sunrise and reaching maximum ionization about noon, and then disappears at sunset. During morning and afternoon hours the layer tends to absorb all waves below 4 MHz. In the middle of the day there also will be a very small amount of absorption to waves above 4 MHz. However, the vast majority of waves above 4 MHz will pass through to the next layer. Most of the absorption in the D layer ends up in the form of heat when the electrons within that area are set into motion as the waves pass through. Signals will not be reflected or refracted from this layer due to the low ion density.

The E Layer

The E layer has a more defined thickness than the D layer, and begins at a height of 50 miles and extends to 90 miles, being most dense at about 70 miles. This layer is also basically a daytime visitor, being most dense about noon and almost disappearing as darkness sets in. However, it will still be strong enough to have some effect on signals during early evening hours. Waves can be reflected and refracted from this layer, and during normal nighttime density 40 meter contacts can be made up to about 1,000 miles. At night the range may drop to 150 miles because of the reduced ion density. There are periods when the ionization is so dense during the day that even 15 meter signals will be reflected back to earth instead of penetrating.

Seasonally, a condition known as *Sporadic-E* shows up in the temperate regions during warm weather. It is the result of heavier than normal ionization in a part of the regular E layer, and can be thought of as clouds of ionization that broke away. The term "cloud" should

"A reflection occurs when a radio wave strikes one of the ionized layers at an angle and bounces off at a similar angle. A refraction occurs when a wave strikes an ionized layer and is not reflected but penetrates the layer."

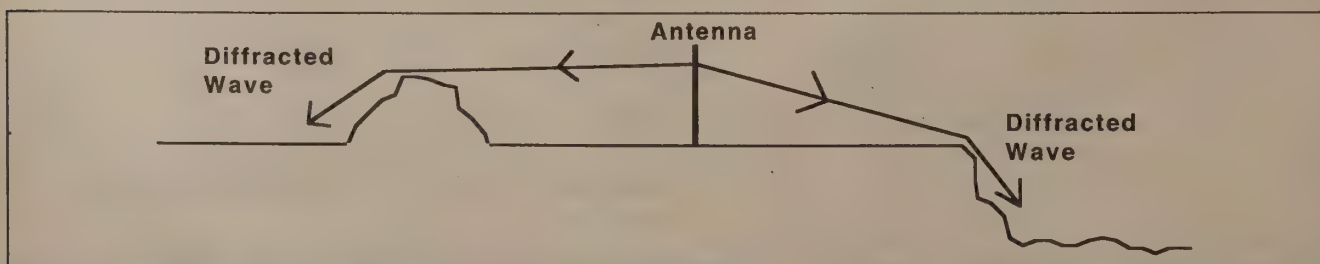


Figure 6. Diffraction.

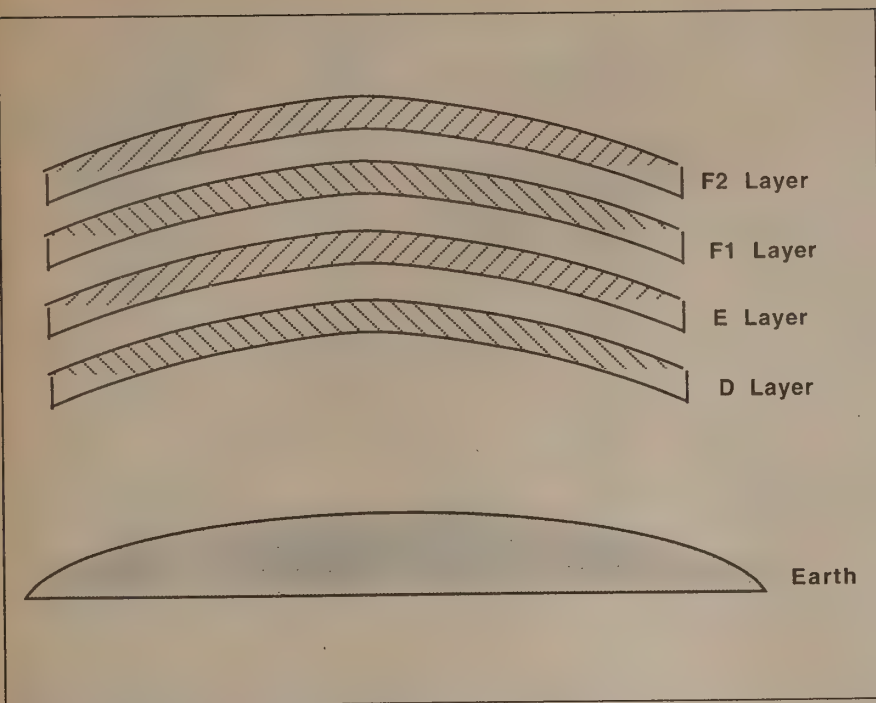


Figure 7. The four ionization layers.

not be confused with regular clouds that are seen in the daytime. The sporadic-E ion clouds can be either stationary or moving, and can range in size from several hundred feet to several hundred miles. Sporadic-E is both good and bad: While it will harm communications on the lower frequencies, it will still provide good distance on the higher frequencies, even those of 150 to 160 MHz.

The F Layers

The next layer of ionization is the F layer, and is wider than the E layer and extends to the beginning of space. During daylight hours this layer will split into two bands, separated by about 50 miles. The lower band is called F1 and the upper F2.

The F1 layer might be called the "Why Is It There?" layer, as it doesn't seem to serve much purpose. Most of the waves that pass through the E layer will also pass through the F1 layer with some absorption to the signal by both layers. Waves that don't penetrate the F1 layer will be reflected downward.

The F2 layer has the greatest ion density because it is the closest to the sun. This layer usually has its highest density between one and two o'clock in the afternoon, and at times this high density will prevail into the early evening hours to provide excellent DX. Under certain conditions waves that passed through F1 will

be reflected off F2 and back to the E layer, and the E layer in turn will reflect them back to F2. This can continue until the signal breaks through either the E layer and goes back to earth, or breaks through F2 and goes into space. In daylight hours F2 becomes the workhorse of the layers.

Radio waves don't stop where the ionosphere ends and space begins. When the right frequency is used and the transmitted wave is at the correct angle to pass through the ionosphere, radio signals will enter space. We know this happens because there is 2 meter moonbounce, and there are communications with the space shuttles. Theoretically, radio waves in space will keep traveling forever. Eventually it may be proven that the waves are absorbed by distant stars or planets—that's another mystery that will have to be solved. But so far there haven't been any reports of the astronauts tuning in to a 1950 World Series game or a broadcast of the old NBC Symphony Orchestra.

Other Factors

There are three more terms that are very important: *critical frequency*, *maximum usable frequency* (or MUF), and *temperature inversion*.

Let's assume we have an all-band high power radio frequency signal generator that we borrowed from the test bench, and let's assume

it's connected to an antenna that will radiate signals only in a vertical direction. Now, let's make another assumption, that we have another antenna connected to a receiver that tracks with the signal generator. After the signal generator is turned on and tuned to a low frequency we should be able to hear in the receiver the signal being reflected back from the ionosphere. We then increase the frequency of the signal generator a little at a time until the returned signal is not heard. At this frequency we know the wave is penetrating the ionosphere and not being reflected, and that the *critical frequency* has been reached. The critical frequency will vary depending on the location of the transmitter, the time of day, and the season of the year.

Once the critical frequency is determined we think we know the *maximum usable frequency*. The MUF is assumed to be the highest frequency that can be used for communications at that time and location because the signal will be reflected by the ionosphere. Because this frequency is an assumption, a safety factor of 15% should be subtracted and that result should be considered the MUF. The safety factor compensates for ionospheric variations that may be present. Thus, if the critical frequency is 12 MHz then 15% equals 1.8 MHz. The 1.8 MHz is subtracted from 12 MHz which gives 10.2 MHz, and this becomes the MUF. But the MUF at the transmitting station can be lower or higher than the MUF that is measured at the desired receiving point, which could lead to trouble. This means that if the MUF is lower at the receiving point it may take several attempts at the transmitting station before the correct frequency is found for communicating. However, if the MUF is higher at the receiving point there is no need to worry. Of course this is assuming there aren't any huge drops in the MUF between the two locations. The MUF may be as low as 5 or 6 MHz during morning hours, but will increase and be at its highest from just before noon to about 2 p.m.

Even though the MUF is determined at a vertical angle there is a *critical angle* at which a signal higher in frequency than the MUF can strike the ionosphere and still be reflected. Trying to make contacts at frequencies above the MUF is very chancy as it is difficult to determine the critical angle and where the reflected signal would strike the earth.

Temperature or thermal inversion is a condition in which a VHF or UHF signal can go astray and become lost to the desired receiving point. It can occur at any time in the tropics or over a large body of warm water, and during the summer months in the Northern Hemisphere.

Air is warmest just above the surface of the

earth and becomes cooler as the height increases. If the warm air becomes trapped above the cooler air it is due to an inversion in temperature, and with an inversion in temperature, a warm air duct is formed. (Think of this as being something like a hot air heating duct in a house.) The ceiling and sides of the duct and its lower edge, which can be the earth, are of such dimensions that only signals 50 MHz and higher will be affected because the waves will fit inside.

Once the duct is formed and the affected frequency is trapped inside, the signal will be reflected back and forth by the four "walls" as it moves along. If the signal is strong enough it can travel the entire length of the duct, which may extend over the horizon. A duct is usually near the ground, but can be at a height of several hundred feet. Temperature inversion can cause loss of TV programs and 6 meter and higher contacts. When a long-distance contact is made via a duct, and probably by accident, it will be found that the receiving and transmitting antennas are located inside the duct.

If diamonds are forever, so are *sunspots*. The radiation from the sun is not the same over its entire surface; there are some areas that can emit immense amounts of radiation. These areas are called sunspots. The number and density of the spots gradually increase until normally they reach a peak every 11 years, although this can vary by a year or two. As the intensity and number of spots increase the solar electrical noise will also increase, and can reach such proportions that it makes the reception of radio signals very difficult or even impossible.

Midway between peaks is a period when sunspots are at a minimum and this can last 12 months or longer. During this low point the MUF of the F2 layer may not exceed 20 to 25 MHz, and yet at peak sunspot activity the MUF can extend into the VHF range.

Sunspots are recorded daily and can be classified as below normal, normal, or above normal. At the peak of an 11-year cycle, normal would be 100 to 120 spots. Sunspots vary in physical size, and some have been estimated to be nearly 80,000 miles or larger in diameter. It is interesting to note that the temperature of the spots are cooler than the rest of the sun's surface.

As we have seen, there are many things that can happen to radio waves in their travels, some good and some bad. You can take advantage of propagation reports like the one Jim Gray W1XU writes for *73 Amateur Radio Today* each month. The study of propagation can be very interesting, and even though this article just touched on the subject maybe it has whetted a desire to learn more.

RF

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the tech side

by Michael Jay Geier KB1UM

Still More "What Is That Thing?"

For the last two months, we've been examining the various kinds of components, with a focus on what their many varieties look like, and some attention to what they do and how they're used. There's plenty more, so let's get back at it! But first, I'd like to relate an interesting experience.

There Are Good People

At the Dayton Hamvention I stumbled upon the Elenco booth. You may have seen their ads for oscilloscopes, digital meters and such. Some time ago I had purchased a couple of 'scope probes from them, and one of the removable clips which lets you hook the probe on a component lead had broken soon after purchase. I got busy and never did anything about it, and at this point the warranty period had long expired. But, when I found myself in front of their booth, I mentioned it, wondering if they might have another clip. They took my name and address but said they had changed models and the new clips wouldn't fit. But, they'd check to see if they had any old ones around. I forgot about it, and, frankly, didn't expect any action; you know how many businesses treat their customers these days. So I sure was happily surprised at the box which arrived soon after I got home. No, they didn't send me a new clip. Instead, they sent me a whole new probe, free of charge! And no, they didn't know I was a columnist, so it didn't have anything to do with that. They're just plain nice people, and it's worth remembering that some are still out there, and who they are. Of course, I'm not suggesting that any company can afford to replace broken out-of-warranty merchandise on a regular basis; I just wanted to recognize some outstanding service by some caring folks. Thanks, Elenco. If there were more people like you in business this country would be in a lot better shape. Now, let's get to our topic.

Coils (inductors): Coils come in many shapes and sizes, and have many uses, including in tuning circuits, as blockers of high-frequency alternating currents, and as transformers, which are used to couple signals between circuit stages at all kinds of frequencies ranging from UHF to audio and all the way down to the power-line frequency of 60 Hz. The basic idea is always the same: a bunch of wire wound around something. Often, the something is a coil form made of plastic or some other noninductive material. In fact, the something may even be air! In any case, as long as the form is noninductive, most of the characteristics of such a coil come from the wire itself. The number of windings, the size of the wire and how it is wound all have substantial effects on the inductance, Q (quality factor, or how much inductance there is compared to how much resistance), distributed capacitance and so on.

Before we go on examining coils, let's pause a moment for a word from our sponsor: distributed capacitance. What the heck is that? Well, consider this: Along a coil's length, an AC signal may be at different voltages on different windings at any given moment, simply because it takes some time for the wave to travel down the wire. Sure, it's very fast but, at high frequencies, the waves are short enough that one end of the coil may be at high voltage while the other end is near zero! So, it makes sense that adjacent windings

may have somewhat different voltages on them. Now, what do you get if you have two conductors, with voltage potential between them, separated by some kind of insulation, be it air, plastic or whatever? Yes—a capacitor! So, in effect there is capacitance distributed all along the length of the coil. Hence the name "distributed capacitance." In a tuned circuit it has the effect of lowering the resonant frequency, as would any capacitor placed in parallel with the coil. Because the material between the windings acts as the capacitor's dielectric, it affects the amount of capacitance. Now, that wasn't so bad, was it? And now back to our show.

Many coils are adjustable. The nearly universal method of changing a coil's inductance is to pass a metal slug through the middle. The slug is not electrically connected to anything, but its presence in the coil's magnetic field causes the inductance to vary because the permeability (ability to "conduct" a magnetic field) of the slug is greater than that of the air it displaces. The more the slug cuts the field, the bigger the inductance gets. So, the slug usually is cut with screw threads which fit into those on the inside of the coil form, allowing the slug's position to be carefully set and controlled.

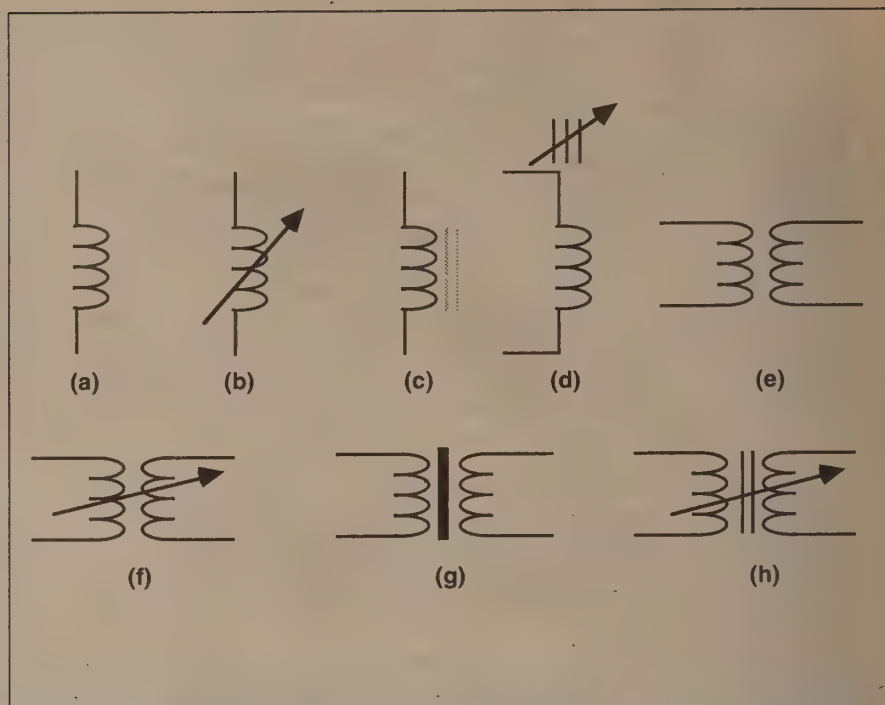
You'll see slug-tuned coils all over the place. Those little, square IF (Intermediate Frequency) cans with the screwdriver adjustments on top are slug-tuned coils. Actually, they're transformers, but those are nothing more than multiple coils wound on one form. (More about them later.)

Sometimes, in order to increase the inductance value for a given number of turns of wire, coils are wound on a metal core of some kind. These days, the toroid, or doughnut-shaped core, is very popular. Toroid coils are unique-looking, having the metal doughnut with wire wrapped around it. It's important to remember that the color of the doughnut is a code; it tells you some characteristics of the metal used, and those matter a great deal. In other words, toroids usually can't simply be exchanged with other types. Luckily, your chances of having to replace a toroidal coil are very small. Unless a whole bunch of current has been pulled through it or it has been fractured or smashed, a toroidal inductor is pretty indestructible.

Many coils are obvious because the turns of wire are plainly visible. Some, though, are not. When a coil is used to block an AC signal, it's called a choke. Chokes come in all kinds of sizes, from the big, obvious ones to little things that look just about exactly like resistors. In fact, those little ones even use a similar color code scheme, with the same kinds of color bands! So, how do you tell them from resistors? It can be hard, but the coils usually are a little fatter and have a bit more of an hourglass shape. The biggest tip-off is when the board marking is L instead of R—L is the universal symbol for an inductor.

Presto Changeo

A special form of coil is the transformer, whose symbol is T. (Male ones are known as Mr. T... just kidding.) Just as a current through a coil creates a magnetic field around it, a magnetic field cutting through a coil generates a current in it! So, why not get some big permanent magnets and some giant coils, and end the energy crisis once and for all? Unfortunately, it just doesn't



A few common schematic symbols: A,B—air core coils; C,D—iron core coils; E,F—air core transformers; G,H—iron core transformers.

work that way. It's the energy in the *change* in the field that generates the current in the coil; the magnetism is just a catalyst. But what if you move the magnetic field through the coil? Yes, then it will make a current, and we call that an electric generator! But, it takes more energy to move the magnet than you get out the other end, and the physical, magnetic opposition to the movement actually will increase as the load resistance across the coil goes down, demanding more current. Oh well, there ain't no free lunch after all.

A transformer works much like a generator, except that the moving magnetic field is created by current in another coil. So, you have two or more coils wound on the same form, causing their fields to cut each other. The first one makes a changing field, and the second one generates a current which matches the change in the field. What's the point? There are several of them. First, there's no electrical connection between the two coils, so a transformer makes a great way to couple power or signals from one place to another with total electrical isolation. Second, the two coils don't have to have the same number of windings! What does that do? Well, in magnetic form, the energy has no voltage or current; it's just a field whose strength is proportional to the total power, in watts, which created it. So, when the second coil reconverts it to electricity, its number of windings has a great deal to do with how much voltage versus how much current you wind up with. Actually, the output is related to a ratio of the number of turns in the first coil and the second one. (There's a square root in there, too, but that's beside the point.) So, if you have lots of turns in the first coil (the "primary") and few in the second (the "secondary"), the output voltage will be lower than the input, but the available current will be higher. And, if you have few turns in the primary and lots in the secondary, you'll wind up with high voltage at low current. The net effect is that the transformer can convert, or transform, current to voltage and vice versa. Pretty slick, huh?

You'll find transformers in lots of areas of your gear, from the power supply to the RF stages to the audio output. In the power supply, both the isolating and transforming characteristics are important because you need a low voltage, often at significant current, to operate the circuitry, and you don't want to get a deadly shock from the ground-referenced AC line. In other stages, the most important chore for the transformer is its transforming ability. Specifically, it helps match the voltage and current capabilities of signals to the stages they're to feed. So, what do they look like?

Many transformers are squarish, and most have two or more leads coming out the bottom of each of two opposing sides. Big power transformers of the kind found in power supplies are usually a couple of inches on a side. They often have paper or plastic covering the windings, but usually you can see them, at least a little. Little signal transformers can take various forms. Some are toroidal, looking just like toroidal coils except for the multiple windings. Others, especially audio transformers, look like miniature versions of power supply units. At radio frequencies transformers can look like slug-tuned coils on round forms, or they can be toroids, or they can, and often do, have metal shield cans around them, like the IF transformers I mentioned earlier.

Coils and transformers usually don't go bad, but pulling excessive current through them can melt the wire or cause a short between windings. A melted wire is easy to find, because you will have an open circuit from one end of the winding to the other. A shorted turn is much harder to determine, and can confound even highly experienced technicians, because often all it does is cause degraded operation rather than an all-out failure. Thank goodness it's a rare event.

There are two other failure modes possible with both coils and transformers. First, the connection between a wire and its connecting pin on a PC-mounted unit sometimes can break, especially if it was poorly soldered to begin with. It doesn't happen often but, when it does, it can be very hard to find, particularly if the problem is thermal or intermittent. I remember running into that one in an IF can once, and it drove me nuts for hours before I pinned it down, because it came and went. And, of course, those connections are under the shield can, where you can't see them.

The final problem concerns coils and transformers which have slugs or toroids or other fragile ferrite-type structures. Sometimes those things can simply fracture, especially if a lot of heat has been involved because of a heavy-current short somewhere in the circuit. A cracked core will severely degrade the coil's performance, even though ohmmeter checks of the windings look perfectly OK. Also, it's possible to permanently change the permeability of ferrite by overheating it, even if it doesn't crack. Usually, though, coils and transformers are unlikely to be the culprits in circuit problems unless there's an open winding somewhere.

Well, we're getting near the end of this series, but there are still a few components to go, so we'll finish up next time. Until then, 73 from KB1UM.

RF



radio magic

by Michael Bryce WB8VGE

Last month we were talking about the driver stage of our small transmitter. This month, we'll finish up with the transmitter and look a bit deeper into the filters used to make the output as clean as we can.

From the driver, the now-amplified signal is coupled to the base of the final transistor. This stage is also called a PA, or Power Amplifier, stage. This is the stage that puts the bang into the antenna.

But, getting power from the driver to the PA is not an easy task. Because the collector of the driver is sitting at a different impedance than the base of the PA, some means of impedance matching must be done. Typically, the base of the PA transistor is very low, around several ohms or so of impedance. The driver's collector, on the other hand, has a much higher impedance. Unlike the other stage when a small-value capacitor was used to couple one stage to another, we can't get away with that method here. Oh, yes, a capacitor would work, but the efficiency in energy transfer would be so bad, most of the RF would never end up at the antenna. So what can we do?

Well, there is an easy way to connect the driver to the PA. It's possible because RF is really just like good ol' AC from the wall outlet, only faster! And just like AC from the socket, we can use a transformer to change the impedance from a high value to the low impedance required by the base of the PA. Because the frequency we're working with is much higher than the 60 cycle stuff from the wall socket, our transformer can be much smaller and require fewer turns of wire. To make it easier for us, we can use a toroid core to wind our transformer.

These cores allow a large amount of inductance in a very small amount of space. Also, a toroid core is self-shielding so external magnetic fields won't cause trouble. This feature allows for some very dense circuit boards. Just look inside your rig and you'll see dozens of coils and transformers wound on toroids.

You can see from the figure that the primary of the transformer has more turns than the secondary. This is how we couple the driver to the PA. It's called induction. We induce a signal on the primary, and pick it off of the secondary. Now, the exact method of computing how many turns on what type of material can get really complex. I for one never like to read page after page of calculations for winding cores and won't make you suffer either.

All you need to know is that the transformer couples the output from one stage to the input of the other stage changing the impedance along the way.

On the base of the PA, you'll notice a small-value resistor. This resistor is used to reduce the gain at the base of the transistor. It's a fancy way of saying that the base of the transistor is kept very close to ground potential. This helps keep the transistor stable. The *swamping* resistor will reduce the amount of power the stage will develop to a certain point by shunting some of our RF drive to ground. By increasing the value of the swamping resistor, we can get more power from this stage—at a cost

of stability. If you increase the value too much the amplifier will start to oscillate. The stage will then increase its collector current. The increase in current makes more gain. More gain makes for a better oscillator. A better oscillator gets more current. And on and on and on until the PA transistor goes out to lunch—and never comes back!

On the other hand, if the value is too low, then you'll have very low output. It's a fine line to walk when designing this stage. You want maximum gain, but with flawless stability.

Notice that on the collector of the PA there are several capacitors and a coil. The purpose of these components is to keep the RF from the collector from getting into the power supply. The small coil is unique in this circuit. It will allow the DC from the power supply to pass to the collector, but it will block the RF produced by the PA to the power supply. That's because the inductance of the coil has been computed to be out of resonance with our operating frequency. In other words, the coil looks like a very high value resistor at 7 MHz, our operating frequency.

The capacitors decouple any stray RF that may appear after the coil. The values are selected to shunt to ground frequencies in the HF, VHF, UHF, and LF (below 1 MHz) range.

The other 0.1 capacitor on the collector couples the RF from the PA into the next stage of the transmitter. The filter stage cleans up the signal before you send it to the antenna. Now, we could have used a transformer instead of a capacitor here. In many designs that is exactly what is done. For our QRP transmitter, a capacitor is simple, cheap and easy. However, a much better match to the collector's output impedance to the 50 ohm input to the filter would yield a great output and that is why you'll see a transformer used.

The main purpose in the life of the PA transistor is to amplify the signal from the driver to the desired output. In the case of your little QRP transmitter, the output will be about 2-3 watts. That's more than enough power to work the world. But, there is one more stage to add before we can connect up our antenna—the output filter.

The energy from the PA is full of harmonics. Besides the fundamental frequency we want, harmonics are generated all over the spectrum. If you were to connect your antenna up to the PA without the filter, you would be sending out critters all over the place. It's also against the rules set down by the FCC. We must transmit as clean a signal as possible.

I won't go into the details of designing a filter for our transmitter. It can get quite complex. It's enough to say the filter will only pass the frequency it is designed for. Any frequencies above the operating

frequency will be greatly reduced. The design and the operating frequency of the filter will decide how clean the output of the transmitter will be. The frequency at which the filter attenuates is called the cutoff frequency. In our case, with an output of 7 MHz, the cutoff would be around 8 MHz.

In some simple transmitters you'll see two capacitors and one coil used in the filter. This is as simple as you can make a filter and still have the transmitter meet the clean signal requirement. I like to use an output filter with one more stage to really attenuate the harmonics generated by the transmitter. Here, two coils and four capacitors make up the filter. You could add even more stages if you want, but the increase in attenuation is not worth the extra components.

In our simple transmitter we have only one operating frequency. Therefore we need only one output filter. Had this been a multi-frequency rig we would need an output filter on each band. As you can see, adding more filters complicates the design of the rig. It's not so much the filters making life rough for the designer, it's switching the proper filter in and out of the circuit as you change bands, and thus frequencies.

This has been a rather simple look at how a transmitter works. You can see that it's a bit easier to get one of these working than a receiver. Transmitters have fewer stages to worry about than receivers; of course I'm not talking about multi-PLL rigs here! The fact is, a small QRP transmitter is an ideal first construction project. If I were you, I would be looking for a good soldering iron.

RF

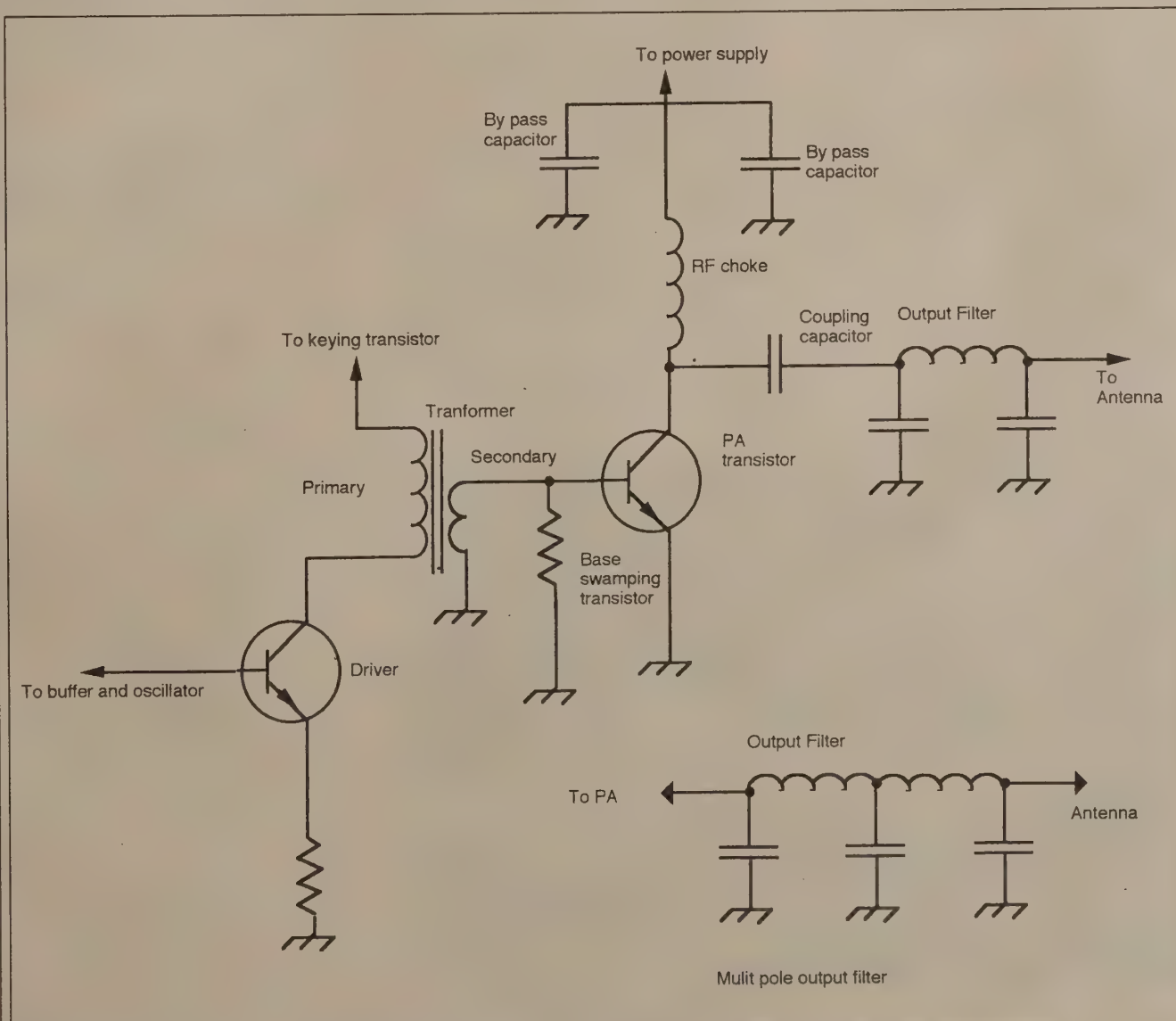


Figure 1. Schematic for a simple ham transmitter circuit.



Joe Carr

antennas, etc.

by Joseph J. Carr K4IPV

Building Wavemeters and Field-Strength Meters

Two of the traditional "first RF projects" made by many hams are the simple field-strength meter (FSM) and the absorption wavemeter. These projects are easy to build, are a good introduction to RF projects, and are quite useful around the ham shack.

Absorption Wavemeters

The absorption wavemeter (Figure 1) is an extremely simple little device for determining the approximate frequency of a signal from an RF power amplifier. The circuit consists of an inductor (L1) and a capacitor (C1) in a resonant circuit. The frequency of resonance is found from:

$$F_{Hz} = \frac{1}{2\pi\sqrt{LC}}$$

Where: F is the frequency in hertz, L is the inductance in henrys (H), and C is the capacitance in farads. When actually working a problem, your units will be in microhenrys (μH) and picofarads (pF), so be sure to convert to henrys and farads.

The indicator is a small, low-current, low-voltage incandescent lamp (I1). I've used lamps with current requirements as high as 600 mA with success around RF power amplifiers, but the low-current (40 mA) type are more sensitive. The shaft of the variable capacitor (C1) is ganged to a calibrated dial from which frequency can be read. In most cases, the capacitor will be installed inside a shielded metal box to prevent environmental and hand capacitance from affecting the reading. The inductor (L1) is constructed so that it is available to the "outside world," i.e. so that it can be used as a probe around RF circuits.

To use the absorption wavemeter, it must be brought close to the tank circuit of the RF amplifier being measured.

WARNING: POTENTIALLY FATAL HIGH VOLTAGES ARE PRESENT IN THIS AREA

IN MOST POWER AMPLIFIERS... LEARN HOW TO WORK AROUND THESE POTENTIALS FROM AN EXPERT (NOT JUST YOUR BUDDY) BEFORE ATTEMPTING TO DO ANY MEASUREMENTS.

The principal use of the absorption wavemeter is not to find the operating frequency of the transmitter. The accuracy is rough at best, so it will not satisfy your normal requirements. However, when building RF circuits, the absorption wavemeter will permit you to determine whether a spurious output is a harmonic or a parasitic oscillation. The difference is that a harmonic will have an integer relationship to the fundamental frequency, while a parasitic probably will not (it's not impossible, but is unlikely, for a parasitic to be harmonically related to the fundamental).

Field-Strength Meters

The field-strength meter is a special case of the absorption wavemeter in which the level indicator is a DC meter, rather than a lamp. Figure 2 shows a circuit that scores of thousands of hams have built over the decades. It uses a small whip antenna (10-24 inches) to pick up a sample of the radiated RF signal, and feeds it inside a shielded enclosure to an LC tuning network. The resonant frequency of this circuit obeys the same relationship as in Figure 1. The capacitor shaft may or may not be calibrated in frequency units, depending on how badly you want to know the operating frequency.

The RF signal developed across the LC tank circuit is maximum when the resonant frequency of the LC pair is equal to the frequency of the radiated signal. Note that the inductor in this circuit, unlike the absorption wavemeter, is not coupled to the circuit under test, so it can be completely within the shielded enclosure.

The signal is rectified by a half-wave rectifier using a 1N60 germanium diode (D1). The germanium diode is preferred over the more modern silicon diodes because the junction potential is less (0.2-0.3 volts for Ge as opposed to 0.6-0.7 volts for Si), and that makes the FSM more sensitive. If you cannot obtain 1N60 diodes, then use equivalents from a radio-TV service replacement line, such as the ECG-109 or NTE-109 devices. Most local radio-TV electronic parts dealers will stock at least one form of these devices.

The pulsating DC signal at the output of the diode is filtered by capacitor C2, and then applied to a meter/sensitivity control network. The sensitivity

control is an ordinary carbon (not wire-wound) potentiometer mounted on the front panel of the instrument. The meter shown here is a 0 to 1 mA DC meter, and it will work fine at all amateur radio power levels. A more sensitive instrument results, however, if a more sensitive meter movement is used. I've used 0-100 μA meters with good success for years.

The whip antenna can be a short piece of wire soldered to the center pin of a coaxial connector (such that it does not short to the shield). Most people, however, use some brass tubing (1/8", available from hobby and model shops), brazing rod, stiff piano wire, or a replacement trans-

sistor radio telescoping FM whip antenna. Figure 3 shows some improvements on the circuit used by a number of people over the years. In Figure 3A we see the use of a coupling link primary winding (L1B) over the "cold" (i.e. ground) end of the tuning inductor (L1A). The signal voltage impressed across the primary is stepped up by the fact that there are more turns on L1A than L1B. This ap-

proach makes the FSM more sensitive, and less likely to be detuned by bringing the antenna close to objects that tend to affect the overall circuit capacitance.

Figure 3B shows another modification (which may be used in conjunction with that of Figure 3A). Here we see the inductor tapped about one-third wave from the ground end, and connected to the diode rectifier (D1). The purpose of this circuit is to match the impedance of the diode. When the low impedance diode is connected across the inductor-capacitor (LC) circuit, it tends to load the LC circuit, reducing its Q and broadening the response.

Figure 3C shows several modifications rolled into one FSM circuit. In this circuit, we see the coupling loop of Figure 3A, and the tapped inductor impedance matching for the rectifier, in addition to the use of a voltage doubler circuit (consisting of C2, C3, D1 and D2). This circuit is, you might say, the "advanced" FSM.

Even more sensitive FSM circuits are found in the amateur radio literature, but most of those use a DC amplifier to boost the output of the rectifier to some higher level. To find these circuits, look to the QRP literature.

One use of the FSM is to adjust final amplifier and antenna tuning unit controls for maximum radiated signal. In the early days of CB, it was popular to adjust the short style of car roof mobile antenna while watching a field-strength meter a few yards away.

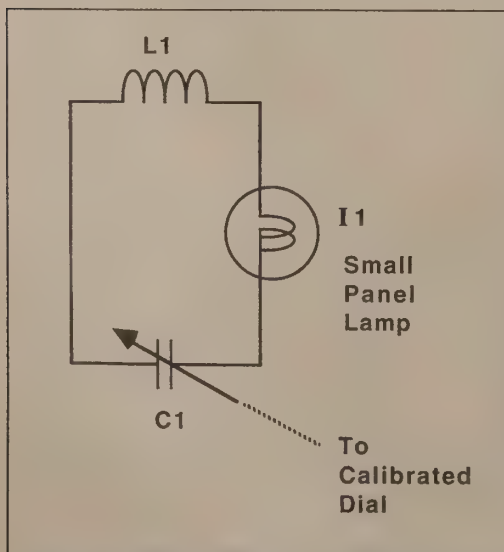


Figure 1. Simple absorption wavemeter.

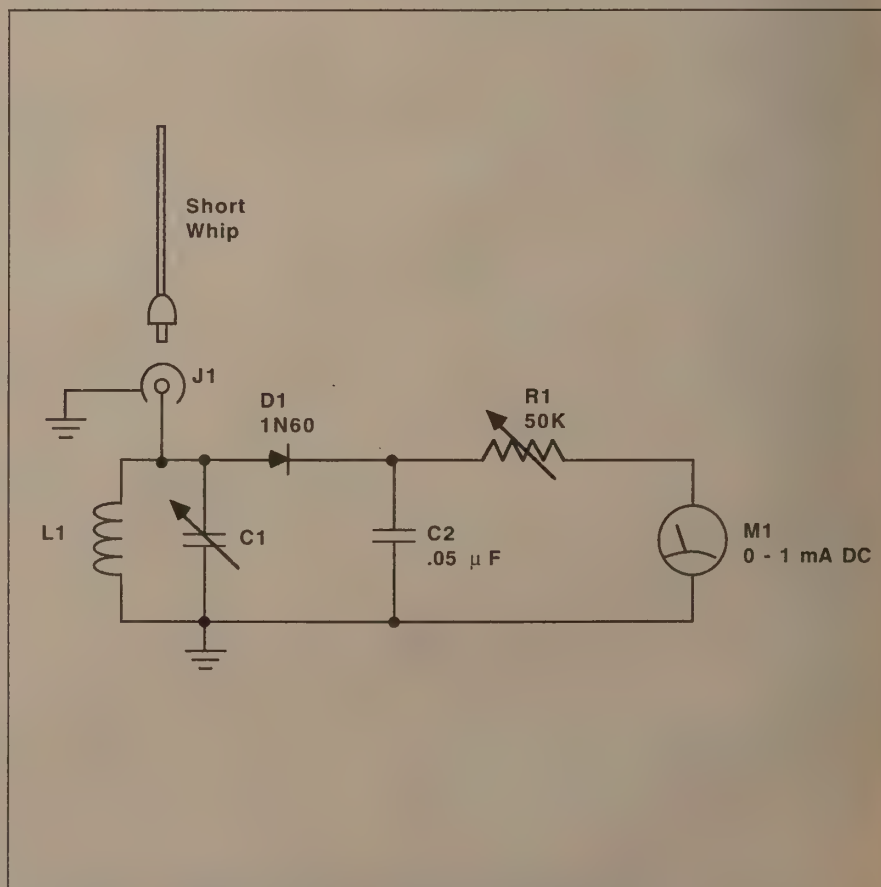


Figure 2. Basic field-strength meter circuit.

Mentoring

Now for a little change of subject. Recently I attended a conference of Quality Management professionals in Washington, DC. The American Society for Quality Control sponsors a program called Koality Kids, which teaches quality control principles to elementary school students. One of the students, 12-year-old Miss Kelly Potter of Pennsylvania, addressed the gathered body of 1,700 adults with as much poise and self-confidence as the adult speakers that day. With kids like Miss Potter around, it's easier to see that this country has a future.

But kids like Kelly don't just happen. It takes good parenting, good teaching and the mentoring of professionals. When you are asked to participate in a program of science, math, technology (or whatever is your forte), please be willing to help. I've judged six or seven science fairs every year for a decade or more, and find it quite satisfying.

And while you're at it, introduce the kid to amateur radio. One of my mentors many years ago used to keep the ARRL license manual and other beginner's stuff on hand to give to kids and adults who inquired about ham radio. Even today, the guys at the EEB retail store close to my QTH are often surprised at my buying a restock collection of beginners literature. Also, introduce the local elementary school and middle school teachers to the hobby. One way to do this is to familiarize them with this magazine and 73 magazine. A good start is to point out Carole Perry's "What's Next" (below), and her 73 column, "Hams With Class."

If you have any questions or topics you would like to see addressed in this column, then contact me at POB 1099, Falls Church, VA 22041.

RF

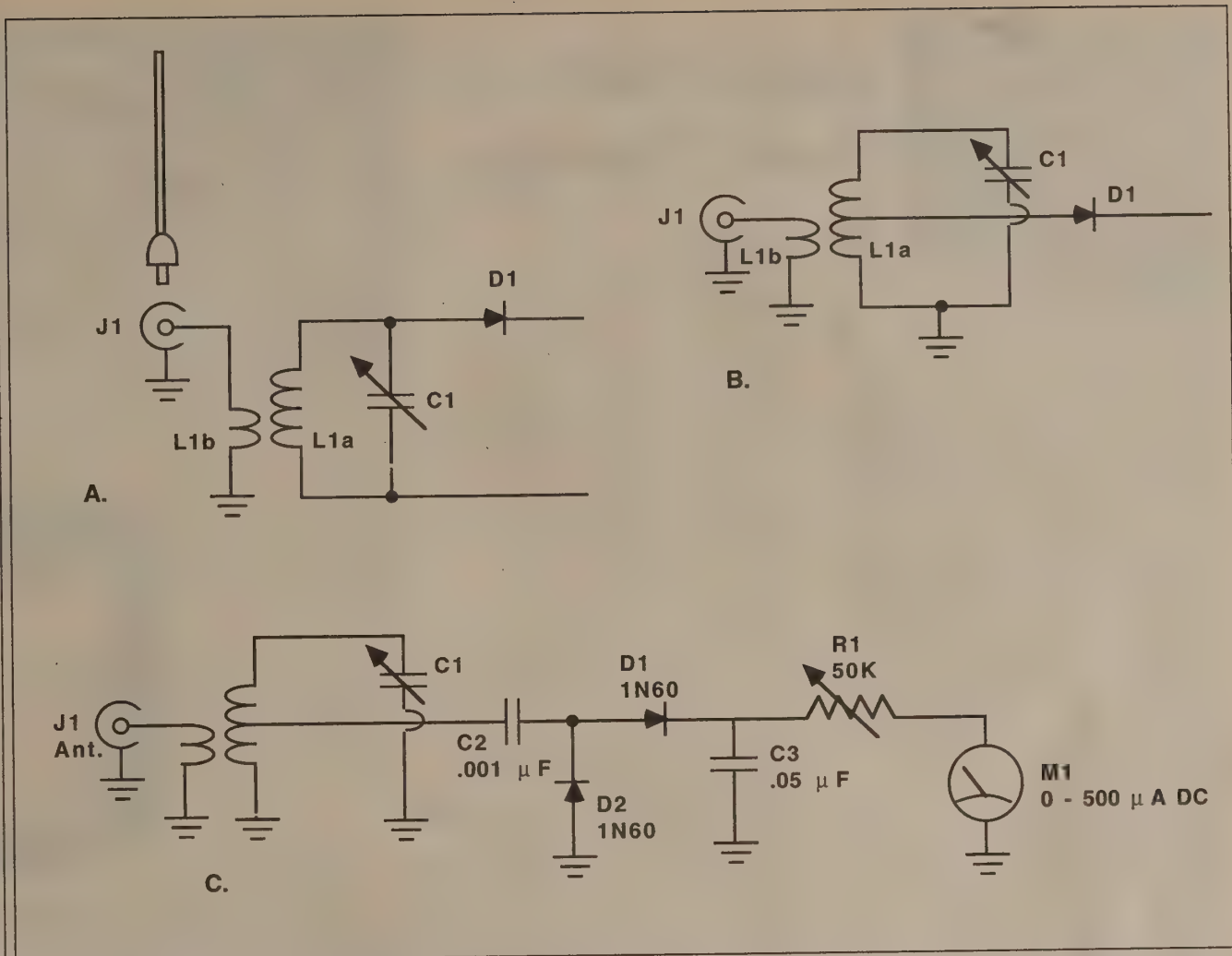


Figure 3. A) Use of a coupling link on L1; B) Use of an impedance matching tap on L1; C) Voltage doubler FSM.



what's next?

Carole Perry WB2MGP

Writing The Right Stuff

In the course of teaching ham radio in a school or radio club, you will probably have occasion to write letters, grants, or publicity articles. The very nature of needing funding or of attracting attention to your program will necessitate the writing of certain materials. It's important, therefore, to review a few basic rules to ensure that you optimize your efforts.

1. Before sitting down at the keyboard, have a clear goal in mind. Know what you want to accomplish with your writing.

2. The first sentence of each paragraph should convey the main thought of the following sentences. Keep your paragraphs short.

3. Sentences should vary in length, but don't make them too long. One study showed that the optimum sentence length was 17 words—when sentences exceed that length they become tedious and you lose readers.

4. Avoid the use of too much jargon. This is especially important when you are writing for local media or to a non-ham-related organization. Be sure to define any words or terms that are peculiar to the hobby.

5. Write in your own style. Don't attempt to copy or imitate the writings of others.

6. Write the way you speak. This will ensure clarity and the use of plain, simple language.

7. Never use a big word when a simple one will do. Choose familiar words. You don't want your readers running to the dictionary to look up every other word. Even worse: You don't want them to misunderstand what you are saying.

8. Use nouns that conjure up "pictures" and "images" rather than general nouns.

9. Use action verbs rather than passive verbs of being.

10. Use simple declarative sentences rather than complicated sentences.

11. Whenever possible, put statements in a positive form. Confusion may arise with too much use of words like "no," "not," "never," and "don't."

12. Be clear about what you are saying. Avoid ambiguities. Your readers should always know exactly what point you are making or what you are asking for.

13. If you are using people's names, or mentioning geographical areas, be sure to get the correct spelling. Always double-check all the spelling of any written work before it goes out. Your paper is a representation

of you in someone else's hands.

14. If you use quotes or refer to other books or articles be sure to give proper credit, through the use of either footnotes or a bibliography.

15. Readers will appreciate your listing references in case they want more information.

16. A good article or letter will end with a way for the reader to know how to respond or inquire further.

17. Studies show that pictures attract the reader's eye. If it's an appropriate situation, include clear, interesting photos with your article.

18. Review your manuscript several times. Be sure that the opening, the body, and the closing are clear, logical, and interesting in format.

19. Provide a sense of closure at the end.

Tell Me About It

Why not try out your writing skills by putting together an article about some interesting and fun thing you did this summer with ham radio? If you or a club you belong to participated in a creative recruiting activity, or if you had some field activities designed especially to attract young people, please write to me about it. If you think you've got some exciting material but you need help in putting the words down, get in touch with me and I'll be happy to help you get started. You're probably a better writer than you think. Here's an opportunity to give your local club or school some good publicity. I'll be waiting to hear from you: Carole Perry WB2MGP, P.O. Box 131646, Staten Island, N.Y. 10313-0006. (718) 983-1416.

RF

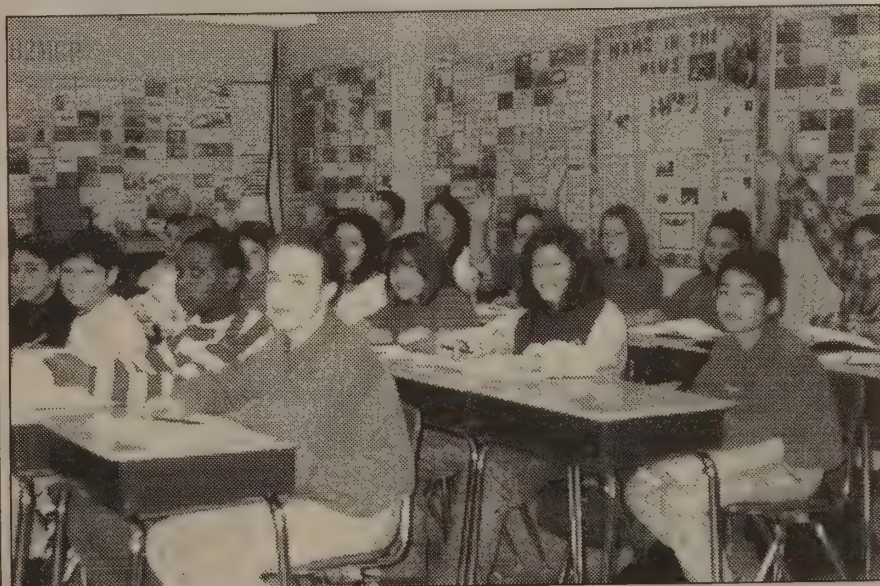


Photo A. With bright students like these, great news stories of their accomplishments are always in order.



upgrade ... don't stop now

by Gordon West WB6NOA

Preprogramming Those Repeaters

There are over 6,000 2 meter repeaters on the air in the United States and Canada. On the 440 MHz band, there are over 5,000 repeaters on the air. There is virtually nowhere in the United States that you could go and not be able to access at least one repeater in your area. Although this might mean climbing out of a deep ravine or going to the top of a nearby hill to get a line-of-sight shot at the repeater, nonetheless, you can access at least one no matter where you go. This fact is based on repeater signal contours researched by Bill Alber WA6CAX, a communications specialist and avid 2 meter operator.

"The biggest problem for newcomers is not necessarily finding a local repeater in their area—the biggest problem is getting that frequency set into their transceivers, including any subaudible tone requirements that the open repeater may have," adds Alber.

The standard repeater offset in the United States for 2 meters is 600 kHz. Only two percent of the 6,000 repeaters use an odd offset. The 600 kHz may be "plus 600" or "minus 600," depending on where on the 2 meter band the repeater output is located.

On the 70 cm band, repeater offsets are almost always 5 MHz. The offset is always a minus 5 MHz on any repeater whose output is above 445 MHz.

The American Radio Relay League's *Repeater Directory* lists more than 20,000 repeaters from 10 meters on up. This book is an absolute must for anyone with a VHF/UHF handheld, base, or mobile radio. It's a bargain at \$6.

One of the best ways to tune into popular repeaters throughout the United States is to preprogram your handheld or mobile transceiver with popular frequencies that are reused in every major city in the U.S. Jay Mabey NUØX, editor of the *Repeater Directory*, suggests the listing in Table 1 as your top 20 plus 20 prememorized frequencies.

Geographical Differences

Different parts of the country may adopt their own band plan, and this is best illustrated in the *U.S. Repeater Mapbook*, available for \$9.95 from Artsci by calling (818)

"One of the best ways to tune into popular repeaters throughout the United States is to preprogram your handheld or mobile transceiver with popular frequencies that are reused in every major city in the U.S."

843-4080. This easy-to-read mapbook clearly illustrates the many areas of the country that may have slightly different repeater band plans. For instance, Southern California is unlike almost any area of the country with repeater outputs above 445 MHz with a -5 MHz input, as opposed to most other parts of the country with repeater outputs below 445 MHz with a +5 MHz input.

Sound confusing? Quite frankly, it is unless you have the *Repeater Directory* or *Mapbook*. But manufacturers are indeed helping

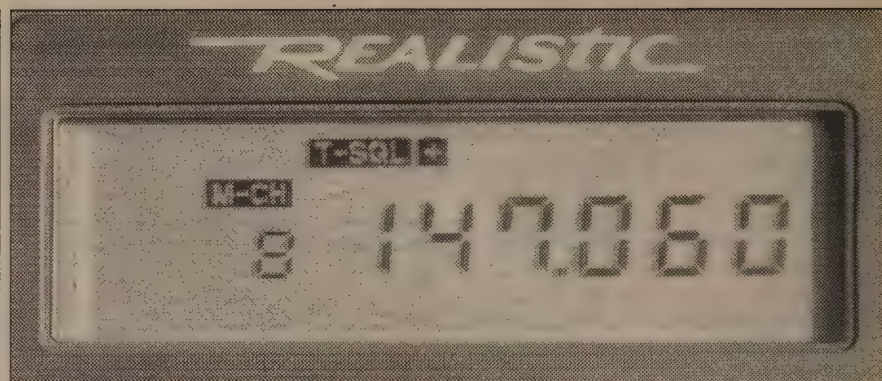


Photo A. The offset and tone setting on this handheld are seen above the frequency display. "T-SQL" means subaudible tone, and the "+" is 600 kHz plus offset.

with handheld and mobile equipment preprogrammed with "automatic offset." This only works if you're in the part of the country that is "normal"! For instance, on the new Kenwood TH-22A, if you have the automatic offset menu item turned ON, and you

dial up 146.820 MHz, it will automatically give you a -600 offset. If you dial up a frequency above 147 MHz, it will give you a +600 offset. But again, check your local repeater directory for what is "normal" for your part of the country—some states separate repeaters by 15 kHz on inverted pairs, yet other parts of the country separate repeaters by 20 kHz.

As of yet, no manufacturer has preprogrammed repeater pairs in the memory. Your new set is ostensibly "brain dead" when you first turn it on. You will need to do the memory process yourself—unless you own a Kenwood TH-78. In about five minutes time you can clone the memory channels from one master Kenwood 78 to any number of other nearby Kenwood 78 handhelds. You can do this right over the airwaves, normally on simplex. It takes about five minutes for 100 channels. If the local radio dealer really wanted a jump on the competition they would clone the popular repeater channels into all

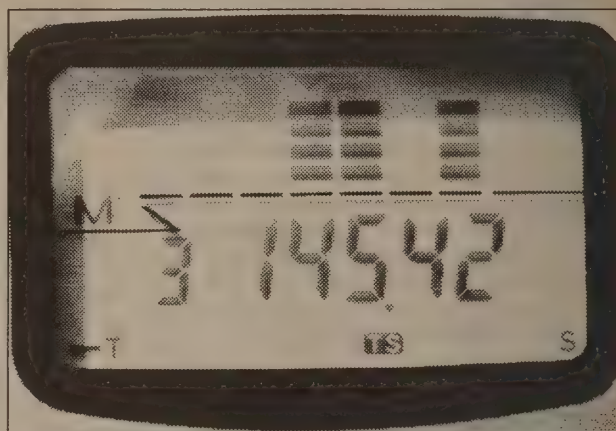


Photo C. Look at the bottom lefthand corner of this HT for the "T" symbol. This means: -600 kHz with tone encode.

new units, and this way the newcomer would get a handheld or mobile VHF/UHF set specifically pre-set to the hot channels in their particular area.

So, your first step in getting preprogrammed is to get an *ARRL Repeater Directory*, and follow it up with the *Artsci Repeater Mapbook*. Then get some local repeater information for your town, and start the memory process. If you travel around the country, preprogram the top 20 VHF and UHF channels for almost-instant operation as soon as you step off the airplane or out of your rental car. And that's the neat thing about 2 meters in a strange city—as soon as you access a local repeater, things aren't quite as strange as they were just a minute before. Maximize your communications enjoyment by preprogramming now. **RF**

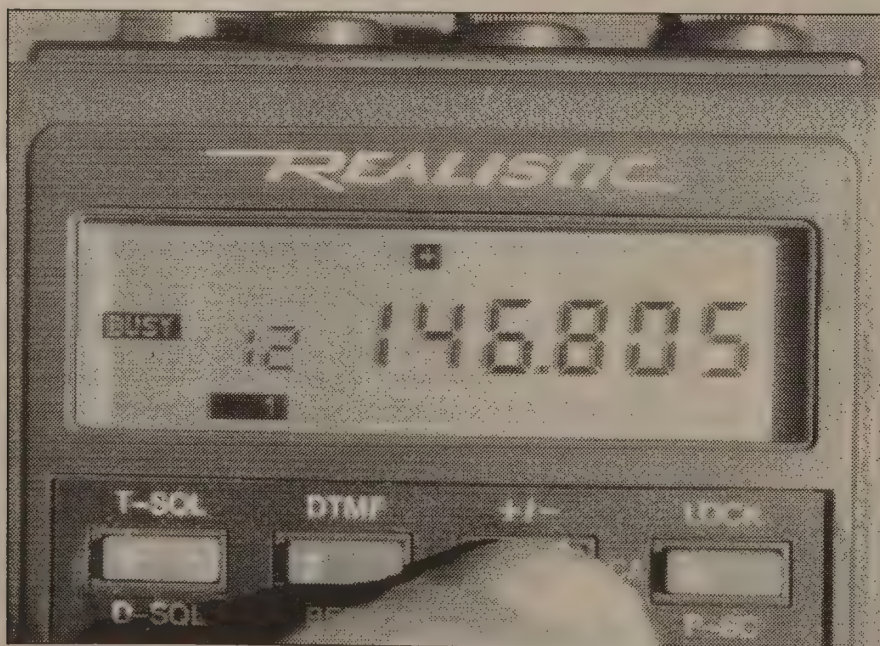


Photo B. Here we see the operator changing the "+" offset to an "-" offset to access this repeater.

Table 1. Popular Repeater Frequencies Throughout the U.S.

2 Meters		70 cm	
146.940	-600	444.500	+5 MHz
146.760	-600	444.100	+5 MHz
146.880	-600	444.700	+5 MHz
146.920	-600	444.800	+5 MHz
147.000	+600	444.900	+5 MHz
146.840	-600	444.975	+5 MHz
146.700	-600	444.150	+5 MHz
147.300	+600	444.200	+5 MHz
147.360	+600	444.000	+5 MHz
146.790	-600	444.850	+5 MHz
147.060	+600	443.900	+5 MHz
146.610	-600	444.300	+5 MHz
146.850	-600	442.000	+5 MHz
146.730	-600	442.250	+5 MHz
147.180	+600	442.900	+5 MHz
147.240	+600	444.400	+5 MHz
147.120	+600	444.550	+5 MHz
146.870	-600	444.650	+5 MHz
146.970	-600	444.750	+5 MHz
145.490	-600	442.400	+5 MHz

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The *Radio Fun Flea Market* costs you peanuts (almost)—comes to 25 cents a word for individual (noncommercial) ads, and 80 cents a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple of months before the action starts; then be prepared. If you get too many calls, you priced it too low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right, and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using.

Send your ads and payment to *Radio Fun Flea Market*, Judy Walker, 70 Route 202 N, Peterborough NH 03458, and get set for the phone calls.

The Deadline for the November 1994 Flea Market is August 18, 1994.

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SEP 30-OCT 1

ISHPEMING, MI The Hiawatha ARA will operate Station KB8DNS Sep. 30th 1700 UTC-0200 UTC, and Oct. 1st 1500 UTC-2000 UTC. This is to commemorate the 40th Anniversary of the Nat'l. Ski Hall of Fame; and the 90th Anniversary of the U.S. Ski Assn. Freq.: General phone and CW Novice on 80, 75, 40, 15, 20, 10, and 2 meters. For a certificate, send a 9" x 12" SASE to Rod KB8DNS, 1740 Rosewood Ln., Ishpeming MI 49849.

OCT 1

ANAMOSA, IA The Jones County ARC will operate N0CWP 1500Z-2000Z, to celebrate their annual Pumpkinfest. Operation will be in the lower 50 kHz of the General subbands. For a certificate, send confirming QSL to Jim McClintok N0CWP, Box 462, Morley IA 52312.

OCT 1-2

PITTSBURGH, PA The Breeseshooters ARC will operate Station W3XX 1400Z-2100Z Oct. 1-2, from the submarine U.S.S. Requin, docked at the Carnegie Science Center. Operation will be CW on 7.123 and 21.123, and phone on 7.250, 14.250, 21.350, 28.460, and 146.52. For a certificate and QSL card, send QSL and an 8 1/2" x 11" SASE to Ron Berry WB3LID, 326 Sunset Dr., Bethel Pk., PA 15102.

OCT 14-16

GREEN VALLEY, AZ The Green Valley ARC will operate KC7MF from 1600Z Oct. 14th-2300Z Oct. 16th, to commemorate the dedication of the Green Valley Titan Missile Museum as a Historical National Monument. Phone Bands: 3.860 (AM or SB); 7.230; 14.250; 21.330; 28.450 MHz. The local 2M Repeater operation will use 145.290 MHz(-600). For a certificate send QSL and an 8" x 12" SASE to GVARC, 601 N. La Cañada, Green Valley AZ 85614.

OCT 29

PISCATAWAY, NJ AA2KS from Long Valley NJ will celebrate Halloween by operating a Special Event Station from the site of "The Ghost of Long Valley." Operation will take place on Oct. 29th for 24 hours. Frequencies: General portion of 40, 20, and 15 meters, and Novice 10 meters. For a special QSL card, send QSL and SASE to Piscataway ARC, P.O. Box 1233, Piscataway NJ 08854. Sponsored by the Piscataway ARC.

activities calendar

Send your announcements to: Radio Fun Activities Calendar, 70 Route 202-N, Peterborough NH 03458. We'll print as many as space allows, on a "first come-first listed" basis.

OCT 1-2

LOUISVILLE, KY The Greater Louisville Hamfest/ARRL KY State Conv. will be held at the Commonwealth Conv. Center in downtown Louisville. Mail requests for tickets or info to *The Greater Louisville Hamfest Assn.*, P.O. Box 34444-Q, Louisville KY 40232-4444. For commercial spaces, call (812) 948-0037. Flea Market spaces, (812) 282-4898.

OCT 2

HUNTINGTON, IN The Huntington County ARS will sponsor its 6th annual Hamfest from 8 AM-1 PM at the PAL (Police Athletic League) Club. Set-up at 6 AM. VE Exams, Flea Market. Talk-in on 146.085/685 and 448.975/443.975. Contact Chris Richardson N9QVI, P.O. Box 284, Huntington IN 46750. Tel. (219) 356-0319.

SAN DIEGO, CA Over a dozen San Diego ARCs, the American Red Cross, and the Salvation Army, will stage the 3rd annual "Ham Radio Roundup." Location: Missile Pk., Missile Rd. & Clairemont Mesa Blvd. Each club or agency (ARRL, MARS, and others) will display the various aspects of amateur radio. Set-up begins at 7 AM; gates open at 10 AM. Contact Harry A. Hodges WA6YOO, (619) 743-4212.

OCT 8

GRAND FORKS, ND The Forx ARC will hold their Hamfest/Computer Fair at Grand Forks Civic Auditorium, 615 - 1 Ave. N., starting at 8 AM. Set-up at 7 AM. VE Exams at 10 AM, walk-ins welcome. Talk-in on 146.94. Contact Bob Smith ND1H, 1203 Shakespear Rd., Grand Forks ND. Tel. (701) 746-9498.

TEANECK, NJ The Bergen ARA will hold its annual Fall Hamfest from 8 AM-2 PM at Fairleigh Dickinson Univ. in Teaneck. Please pre-register for spaces with power. VE Exams, Talk-in on 146.790, 190. Contact Jim Joyce K2ZO, (201) 664-6725. Please, no calls after 10 PM.

OCT 8-9

MEMPHIS, TN "MemFest '94" Greater Memphis Amateur Radio/Computer Show will be held at Shelby Farms Show Place Arena, 105 Germantown Pkwy., in Germantown TN. The Greater Memphis Amateurs will host this event Sat. 8:30 AM-4 PM; Sun.

8:30 AM-2 PM. VE Exams both days 9 AM-Noon. Talk-in on 144.61/145.21, 447.00/442.00 and 1272.00/1292.00. For Flea Market info, contact Lee Bowers KA4KVV, (901) 867-3461 after 6 PM. For general and exhibitor info, call Steve Fletman KC4ZOV, (901) 363-3159 after 4 PM; or Mary Moore AC4GF, (901) 758-0661.

OCT 9

DURHAM, CT The Meriden ARC, the Middlesex ARS, and the Shoreline ARC will co-sponsor the Nutmeg Hamfest and CT State ARRL Convention at the Fairgrounds on Route 17 in Durham. Time: 9 AM-3 PM. Campsite and vendor setup at 4 PM Sat., Oct. 8th. VE Exams; call Ted Tridel, (203) 345-4008 to register in advance. Computer Flea Market. Talk-in on 145.29 Rptr. Vendors contact John Bartscherer, (203) 238-2453, days. For general info, call Jim McCandless, (203) 349-3353 eves. Packet: N1GNY @ WINRG.CT.USA.NA; Internet: wilsonc@tia.org.

LIMA, OH The Northwest Ohio ARC will hold a Hamfest at Allen County Fairgrounds. Doors open at 8 AM. Set-up after 4 PM Sat., Oct. 8th. VE Exams, all classes pre-register with completed 610 and check for \$5.75 payable to ARRL/VEC. Send to Jon Solomon, 1370 Stevick Rd., Lima OH 45807.

OCT 15

WAYCROSS, GA The Waycross Area Rptr. Assn. 3rd annual Hamfest will be held at Waycross Ware County fairgrounds Exchange Club bldg., Hwy. 82 East, Open 8 AM-4 PM. Talk-in on 146.640 rpt. License exams, all classes, at 9 AM. Contact Don Minchew KD4CEX, (912) 283-9553; Woodrow Kirtin N4UNC, (912) 449-5357; or write or call David Sweat KD4FGC, 3492 Wren Dr., Waycross GA 31501. Tel. (912) 283-4603.

OCT 16

BENSALEM, PA The Penn Wireless Assn. will hold its annual TRADEFEST from 0800-1400 hours at the Robert Yezzi Fairgrounds on Hulmeville Rd. Auction. Vendor setup at 0600. Pre-register by Oct. 1st to PWA, P.O. Box L-734, Langhorne PA 19047; or call John N3NUB, (215) 355-0879. VE Exams, Exhibits. Talk-in on 145.25/144.65, 146.925/146.325, 448.225/443.225 and 146.52 simplex.

OCT 23

SELLERSVILLE, PA The Sellersville Nat'l Guard Armory will be the location for a Special Event that will be held by the RH Hill ARC. VE Testing starts at 9 AM, all classes. Bring documents. Contact Linda Erdman, (215) 679-5764; or P.O. Box 29, Colmar PA 18915.

WARREN, MI The "USECA SWAP" will be held at Macomb Comm. College, South Campus Student Comm. Center (K-Bldg.) at 12 Mile Rd. & Hayes. Doors open at 8 AM. VE Testing, pre-registration required: call Bill N8CVC, (313) 468-8345. Computer Hardware/Software, Ham Gear, Electronic Parts, Connectors and Cable. To register for tables, call Virginia N8NLS, (313) 268-0691 or Kevin N8QVX, (313) 772-8082. Talk-in on 147.18(+/-) or 146.42 simplex. Make checks payable to U.S.E.C.A. and mail with legal size SASE to Virginia Przeka, 34473 Couchwood Dr., Sterling Hts MI 48312. This event sponsored by Utica Shelby Emergency Communications Assn.

OCT 29

MOBILE, AL The Mobile ARC will hold its Ham/Computer Fest at ABBA Shrine Temple, 7700 Hitt Rd., off Schillingers Rd., from 8 AM-4 PM. VE Exams start at 9 AM: bring a copy and original of your current license, copy and original of current CSCE, two IDs (one must be a photo) and \$5.75. Contact Louis AC4EN. Talk-in on 146.22/82. Ragchew on 146.34/94. For more details, contact Richard Ireland KD4TTD, (205) 824-2749, or write M.A.R.C., P.O. Box 81791, Mobile AL 36689.

ST. PAUL, MN The Twin Cities FM Club will celebrate the 10th Anniversary of the Hamfest Minnesota & Computer Expo! The event will be held in the main arena at the St. Paul Civic Center, at Kellogg & West 7th St., from 8 AM-4 PM. For info and advance registration, write to *Hamfest Minnesota & Computer Expo*, P.O. Box 5598, Hopkins MN 55343, or call the Hamfest Minnesota Info Line at (612) 535-0637.

OCT 30

LEBANON, IN The Boone & Clinton Co. ARCs will stage a Special Event at Boone Co. 4-H Fairgrounds, Warm & Dry Comm. Bldg. Flea Market. VE Exams. Talk-in on 147.105 and 443.150. Contact Sam Paul WA9YZE or P.O. Box 186, Lebanon IN 46052. **WESTMINSTER, MD** The Radio Clubs of Carroll County MD and Penn-Mar PA will hold the 5th annual Mason-Dixon Computer/Hamfest at the Carroll County Ag Center in Westminster MD. Setup at 6 AM. Opening at 8 AM. VE Exam registration begins at 8 AM, pre-registration requested. Talk-in on 145.41 MHz.

new products

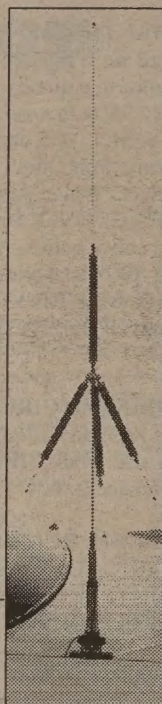
NCG COMET

Comet Antenna has introduced the new Quad-Band HF mobile antenna, Model HA-4S. The following coils are standard with the HA-4S: 40, 15, 12, and 10 meters. An optional 20 meter coil is also available: the L-14HS.

The HA-4S is very compact and lightweight, weighing only 1 pound 14 ounces and measuring only 4 feet 10 inches tall. This allows for more convenient mounting options than conventional HF mobile antennas. The HA-4S can be mounted on a trunk lip-style mount such as the RS-820, or a rain gutter mount such as the RS-80.

High quality construction includes a gold-plated PL-259 connector at the antenna's base and a threaded collar that unscrews to expose the hinged base, allowing a 90-degree foldover for clearing garage doors, etc.

For more information on the HA-4S, visit your favorite dealer or contact *NCG Comet*, 1275 North Grove St., Anaheim CA 92806; (714) 630-4541, FAX (714) 630-7024. Or circle Reader Service No. 202.

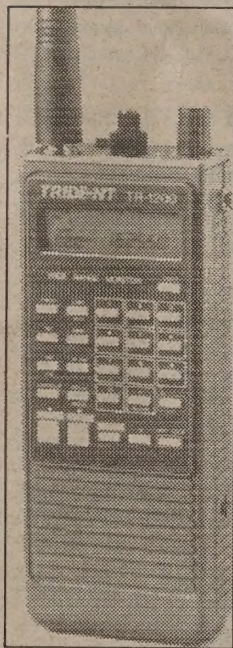


ACE TRIDENT

A new hand-held radio receiver covering shortwave and public service band voice frequencies has been introduced by Trident. Frequency coverage ranges from below AM broadcast (500 kHz) to above the new PCS frequencies (1.3 GHz) in the microwave range. Listeners can tune into virtually every kind of voice broadcast, from all over the world.

This new Trident demodulates AM, narrowband FM, and wideband FM signals. Frequencies can be directly entered in the keypad, or the unit will scan for active channels. The receiver has 1,000 permanent programmable memory channels.

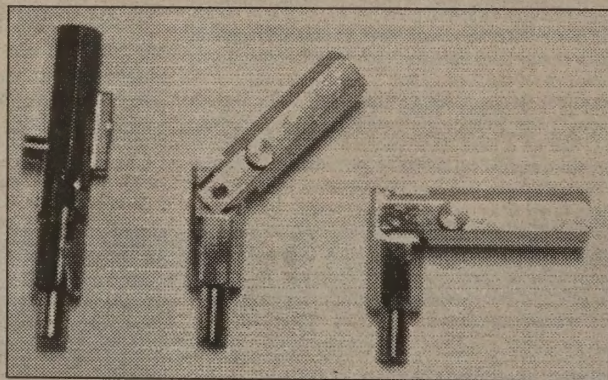
The new Trident comes with a 12 VDC cigarette lighter plug, AC battery charger, four AA batteries, earphone, built-in speaker, belt clip, flexible antenna, mounting hardware, and instructions. For more information contact *Ace Communications*, 10707 E. 106th Street, Fishers IN 46038; (800) 445-7717, FAX (800) 448-1084. Or circle Reader Service No. 203.



ANTENNA SALES & ACCESSORIES

ASA has introduced the Fold-Over Model FO-1, three-position adapter for 3/8 x 24 thread antennas, which fits any 3/8 x 24 mount. This unique mount adapter eliminates having to take the antenna off the vehicle when approaching home garages, drive-up bank tellers, and parking garages.

Just push the side button on the FO-1

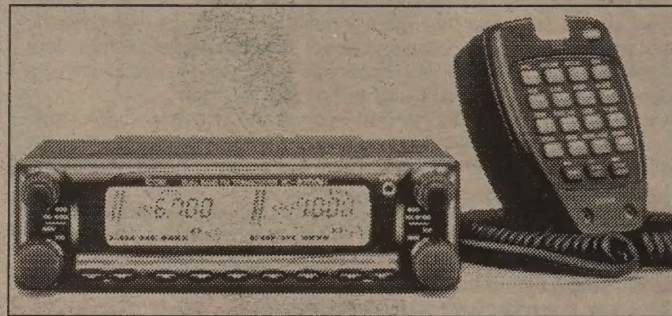
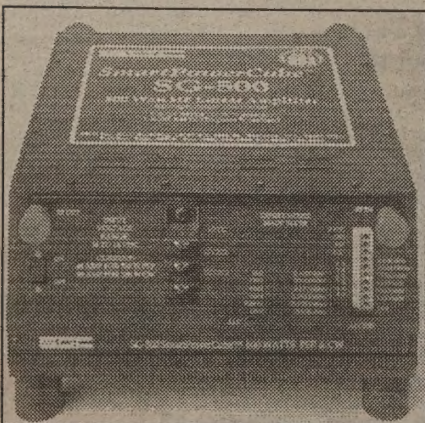


and fold over to 45 or 90 degrees.

The heavy-duty unit is constructed of weatherproof chrome-plated brass and stainless steel. They are priced at \$7 each or three for \$20 (add \$5 S & H USA, to one location). For more information contact *ASA*, PO Box 3461, Myrtle Beach SC 29578; (800) 722-2681. Or circle Reader Service No. 205.

SGC

SGC has announced the availability of the new SmartPowerCube microprocessor-controlled linear amplifier. The unit significantly boosts power 500 watts intelligently. The unit has a bank of status LEDs on the front panel which function as Built-In Test Equipment (BITE) allowing the operator to spot any problem quickly.



ICOM

Icom has introduced the IC-2700H dual-band mobile transceiver, featuring a detachable front panel. Mount the front panel on your vehicle's dashboard and store the main body in another location, using the optional OPC-438 or OPC-439 accessories. The careful design and dual controls allow for safe and convenient operating while driving.

The IC-2700H features VHF (144 to 148 MHz) and UHF (440 to 450 MHz) coverage,

phone. Adding the optional HM-90A wireless mike allows "back-seat driver" of the transceiver.

Each band has six scratchpad memories and the IC-2700H provides a total of 100 memory channels. Output power is 50 watts VHF and 35 watts UHF. The suggested retail price is \$959. For more information, visit your Icom dealer or contact *Icom America, Inc.*, 2380-116th Avenue N.E., Bellevue WA 98004; (206) 454-8155. Or circle Reader Service No. 201.

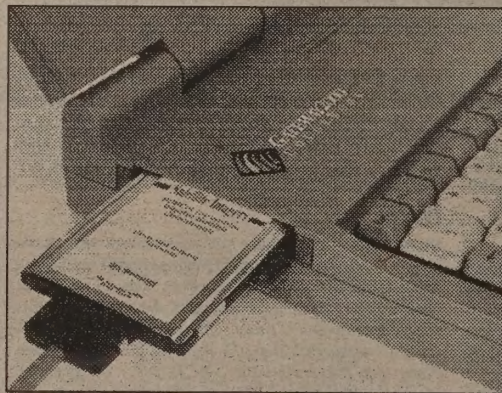
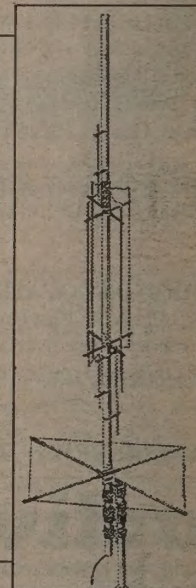
GAP ANTENNA PRODUCTS

GAP Antennas has introduced the Titan DX multiband antenna. The Titan provides continuous coverage under 2:1, across the entire 10, 12, 15, 17, 20, 30, and 40 meter bands. Plus, it covers over 100 kHz on 80 meters. The Titan is pretuned; it needs no tuner.

The Titan is the answer for the amateur with space limitations. It's easy to set up, requiring no radials. It simply mounts on a 1-1/4" pipe. The Titan is a very manageable 25 feet and weighs 25 pounds.

Like all GAP antennas, the Titan has no traps or coils, but has the unique elevated GAP feed which dramatically reduces earth loss, noise, and instability. Sturdy construction features 6063 aluminum tubing and stainless steel hardware.

GAP antennas are manufactured in the USA. For more information visit your favorite dealer or contact *GAP Antenna Products, Inc.*, 6010 N. Old Dixie Highway, Vero Beach FL 32967; (407) 778-3728. Or circle Reader Service No. 204.



OFS WEATHERFAX

OFS WeatherFAX has announced a third-generation weather satellite demodulator—the PCMCIA Convertible for laptop and desk computers. This is the first WeatherFAX decoder card to use Carrier Peak Sampling (CPS) technology, which provides noticeable improvements in image quality

and clarity. Whites are whiter, blacks are blacker, gray shades are more accurate, and boundary edges are well-defined. The quartz crystal-locked digital design eliminates all adjustments, and self-test modes verify correct operation.

The compact PCMCIA Convertible is credit-card (PCMCIA Type II) sized and is hot-plugable into IBM compatible laptops and desktops, using the OFS ISA bus converter card. When attached to the audio output of an SSB or VHF receiver, it will acquire high quality weather satellite pictures directly from polar-orbiting and geostationary satellites and from HF Marine FAX.

Prices start at \$495. For more information contact *OFS WeatherFAX*, 6404 Lakerest Ct., Raleigh NC 27612; (919) 847-4545 (voice or FAX). Or circle Reader Service No. 206.

The SmartPowerCube constantly monitors your HF SSB rig's activities, power needs, and antenna condition. In less than 15 milliseconds it selects the right broadband filter. The unit is protected from preprogrammed shutdown procedures and shuts down automatically in the event of a microprocessor fault.

The SG-500 SmartPowerCube is

designed for service in fixed, mobile, and marine applications, and is fully compatible with most HF equipment. The introductory price is \$845 for a limited time. For more information contact *SGC Inc.*, SGC Building, 13737 SE 26th St., P.O. Box 3526, Bellevue WA 98009; (206) 746-6310, (800) 259-7331, FAX (206) 746-6384. Or circle Reader Service No. 207.

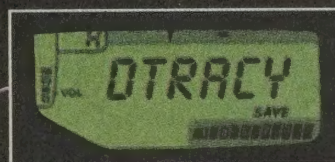
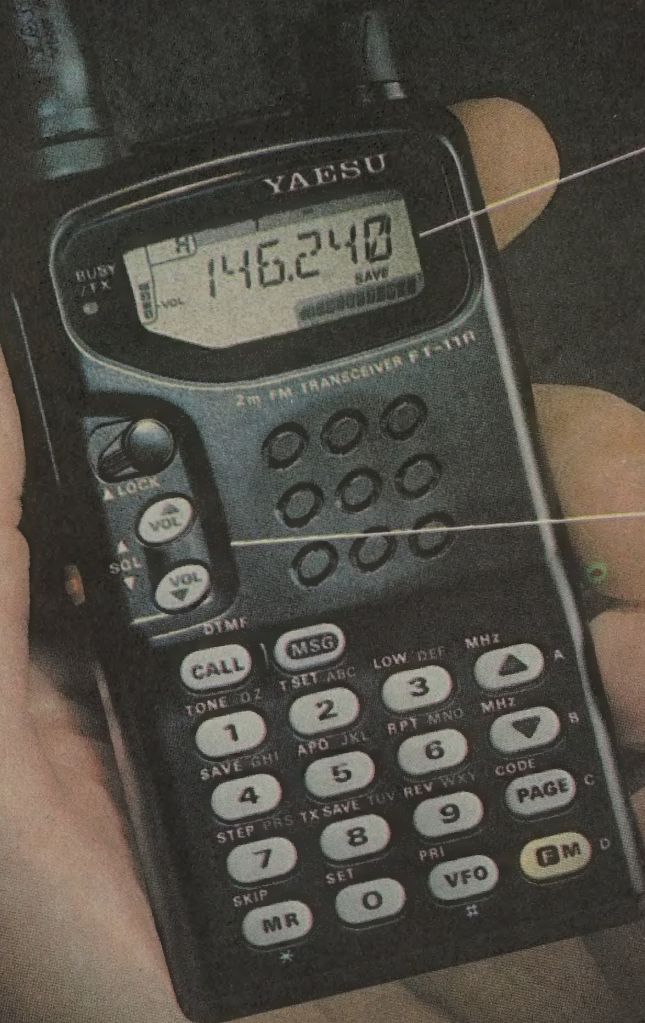
FT-11R/41R 2m/70cm Handhelds

- **Frequency Coverage:**
Wide Receiver Coverage:
FT-11: 110-180 MHz RX,
144-148 MHz TX
FT-41: 430-450 MHz RX/TX
- Selectable Alpha Numeric Display
- New Compact Battery Design
4.8V produces 1.5 Watts
9.6V produces Full 5 Watts
- 150 Memory Channels
(75 when Alpha Numeric)
- AM "Aircraft" Receive
(110-136 MHz)
- Small Compact Size w/ Easy Operation (measures only:
4"H x 2 1/4"W x 1"D)
- Rx/Tx Battery Savers
- High-efficiency MOS FET Power Module
- Large Back-Lit Keypad and Display
- Up/Down Volume/Squelch Controls
- Built-in DTMF Paging/Coded Squelch
- Automatic Power Off (APO)
- **Accessories:**
FNB-31 4.8V, 600 mAh Battery
FNB-33 4.8V, 1200 mAh Battery
FNB-38 9.6V, 600 mAh Battery
FBA-14 6 AA Size Battery Case
FTS-26 CTCSS Decode Unit
NC-50 Dual Slot 1-Hour Desk Charger
CA-10 Charge Adapter
(required w/ NC-50)
Contact your Dealer
for full details.

"Look, alphanumeric display and a 4.8V battery. Terrific!"

"Small and thin – with a full sized keypad! How'd they do that?"

"Yaesu did it again!"



NEW Alphanumeric Display

First time for Yaesu HT Full function LCD combines letters and numbers.

NEW Up/Down Thumb Control with Volume and Squelch Bar Graph. No other radio has this. Back lit, too!

NEW Compact Battery Design 4.8V gets you 1.5 Watts. A first for amateur radio.

Get a grip on this!

World's smallest size HT with a full sized keypad Measures only: 4"H x 2 1/4"W x 1"D

"Small" is relative, isn't it? It could mean size – which in this case it does. And, it could mean "reduced", which it doesn't! Nothing missing from the hot new FT-11R HT from Yaesu except bulk! You're going to wonder just how all the features of this full-function radio fit in. Until you remember Yaesu pioneered 2-way radio micro technology.

To see what this really means to you,

check out all the new features. Like the alphanumeric display. This Yaesu HT first, lets you tag your favorite frequency by name, call sign or number. Or, the new "voltage stingy" battery. It's an industry first for amateur radio. Smaller and compact, the 4.8V battery gives you 1.5 watts on TX. And, if that's not enough, there's an optional drop in, dash mount battery charger.

You see it's not a small time performer. Just small sized. The FT-11R. Another small example of Yaesu superiority. See your dealer today!

YAESU

Performance without compromise.SM

Kenwood's TH-22AT/42AT: The Compact Solution!
144 MHz/450 MHz single band HTs

More Power !

**CASH BACK
SPECIAL OFFER !**

See Kenwood
dealer for details
(expires Nov. 30, 1994)

99¢

for a DELUXE CORDURA
SOFT CASE with purchase
of a TH-22AT/42AT
now through Dec. 31, 1994.
See Kenwood dealer for details

Features

- 3-watt output from MOS FET power module and supplied 6-volt battery (TH-22AT: approx. 3 watts, TH-42AT: approx. 2.5 watts), and 5-watt output with optional PB-34!
- Compact design: 2-3/16 x 4-5/8 x 1 in.
- Built-in DTMF keypad with monitor
- Built-in DTSS page system ■ Large 1-7/16" speaker
- 41 EPROM channel memories (including 1 call channel)
- Multiple scan functions (VFO, call & memory)
- Carrier-operated & time-operated scan stop modes
- Tone alert with elapsed time indicator
- Battery-saver circuit and auto power-off function to extend battery life ■ Selectable squelch configuration
- RF output power control (Hi/Low/EL)
- Built-in CTCSS encoder, optional TSU-8 decoder (any tone can be stored in any channel)
- User-friendly menu system to customize your operating preferences ■ Easy to program and use
- Modifiable for MARS and CAP. Specifications guaranteed for Amateur bands only. Permits required for MARS and CAP use.
- Wide range of accessories to enhance operating convenience and enjoyment

Slim, compact, lightweight. These words describe the exterior of the new TH-22AT Series HTs. Rugged, innovative, sturdy. These words describe what is on the inside. Because along with the beauty, this new series of HT has all the things you want in a portable communications package. Like a streamlined, easy to program interface, one touch controls, and a simplified menu of functions that you can customize to suit your needs. Even a DTMF memory that stores five of your favorite 15-digit telephone numbers for autopatch use. Wide band receive - 136 to 173.99 MHz. A new innovative microprocessor and final amplifier circuit enables a full five watts, while conserving battery power. (The supplied battery provides 3 watts.) Easy mobile operation with optional PG-3H cable.

As always, a full line of accessories is available to enhance your operating enjoyment!

See your favorite Authorized Kenwood Amateur Radio Dealer for all the details!

Modifiable for MARS/CAP use.
Permits required. Specifications
guaranteed for Amateur band only.

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KENWOOD ELECTRONICS CANADA INC.
6070 Kestrel Road, Mississauga, Ontario L5T 1S8

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